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Large Fixtures and Tools for Building Twin City Tractors

By Howard Campbell
Western Editor, *American Machinist*

Details of operations on large automotive units—Boring two camshaft bearings and the crankshaft bearing at the same time—An English gear planer—Machining 12-in. connecting rods

THE TASK of building the modern iron horse, as performed in the plant of the Minneapolis Steel & Machinery Co., Minneapolis, Minn., is unusually interesting. The engine parts are considerably larger than those in the average automotive unit, yet high standards both of production and accuracy are maintained.

The size of the parts necessitates different equipment in the way of tools and fixtures so that, while many of the principles employed in machining automobile parts can, of course, be employed, the application must be modified to suit the changed conditions. The handling of heavier parts also presents a different and more difficult problem than confronts the builder of automobiles. For methods which give high production when the parts are light may be disappointing when the work has to be handled with a crane or hoist.

The rough stock department is equipped with two machines similar to the one shown in Fig. 1, which is a Gorton cutting-off machine. The job in process in the illustration is that of cutting off a section of 5-in. chrome nickel steel bar. The bar is clamped in a V-shaped rest by a pin held in position by the action of an air-cylinder in which the pressure is maintained at from 90 to 100 lb. per sq.in. The cutter is circular, with ten blades, each ¼ in. thick, projecting into a 10-in. hole. Power for the cutter is supplied from a 40-hp. Wisconsin electric motor, driving the cutter at a speed of 12 r.p.m. The time required to cut off the bar is 4½ minutes.

An Ingersoll milling machine is shown in Fig. 2, milling the sides of two transmission cases. The two pieces are held in a fixture built in three sections so that each piece is clamped to the side of one section and held by pins at the opposite upper corner to another.

The fixture and work are both steadied by the heavy bar which can be seen extending lengthwise across the top of the three sections of the fixture. This bar travels through a substantial guide located on the cross-rail of each machine as shown. There are three spindles on each side of the machine, each carrying an inserted tooth cutter, the upper one being 14 in. in diameter.

This method of supporting or steadying the top of both the fixtures and the work has many advantages which can well be adapted to many other operations where the pieces to be machined extend a considerable distance above the table, or point of support. The block on the cross-rail through which the bar slides forms an admirable support against any side thrust of the cutters which might come from unequal metal on either side. Blocks are attached to the sides of the fixture sections for use in setting the cutters, an idea that saves a great deal of time and trouble. Usually about $\frac{1}{16}$ in. of stock on each side of the castings is removed in one cut, the dimensions being held within 0.010 in. The cutters make 16 r.p.m. and travel ¼ in. per revolution, finishing the two pieces in approximately 30 minutes.

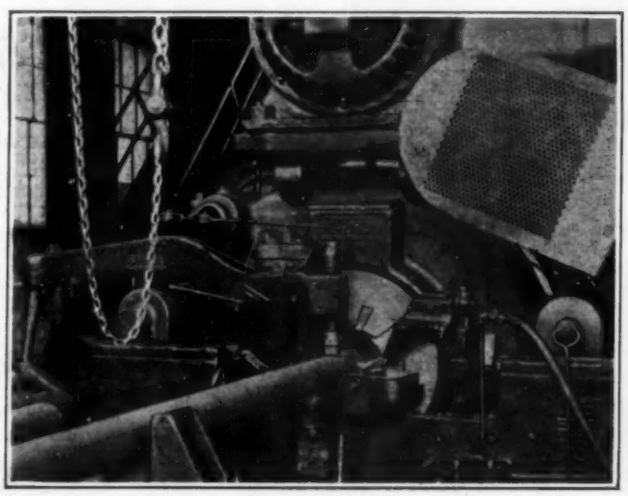


Fig. 1—Gorton cutting-off machine

The drilling of the transmission case, which is done on a Dreses radial drill, is shown in Fig. 3. The holes are drilled through jigs that are clamped to the sides of the casting, the large drills running at a speed of 190 r.p.m., and the smaller ones at 400 r.p.m. The operator drills twelve

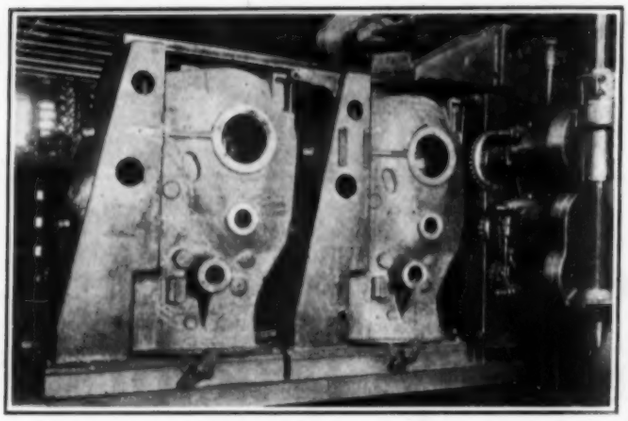


Fig. 2—Milling tractor transmission cases

¾-in. tap holes, sixteen ½-in. tap holes, one 1 23/32-in. hole, one 1 5/8-in. hole, one 1 1/16-in. hole, two 31/32-in. holes, and one 1 1/32-in. hole, and finishes the job in an hour.

Operations on the Motor Base

A motor base of which the end is being bored and faced on a Putnam lathe, is shown in Fig. 4. The piece is clamped to a fixture that is supported by the tailstock center, and is counter-weighted on the faceplate. Approximately 1/8 in. of stock is removed in two cuts, all but about 0.010 in. being taken off in the first one.

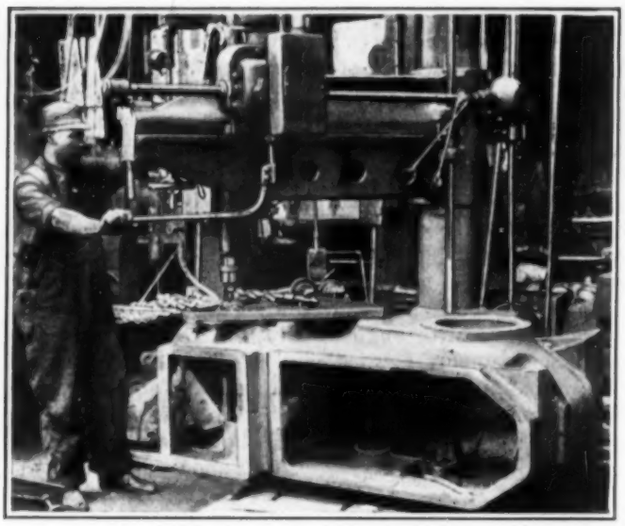


Fig. 3—Drilling holes in transmission case

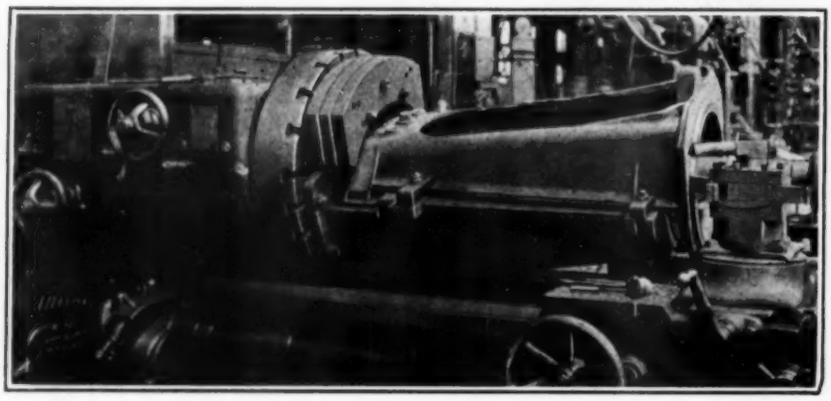


Fig. 4—Boring and facing motor base

The feed for the roughing cut is 3/32 in. and for the finishing cut, ¼ in. The diameter of the hole is held to a limit of 0.010 in., and 13 pieces are finished in 8¾ hours.

A crankcase for one of the smaller types of motors is shown in Fig. 5, being drilled in a Pawling &

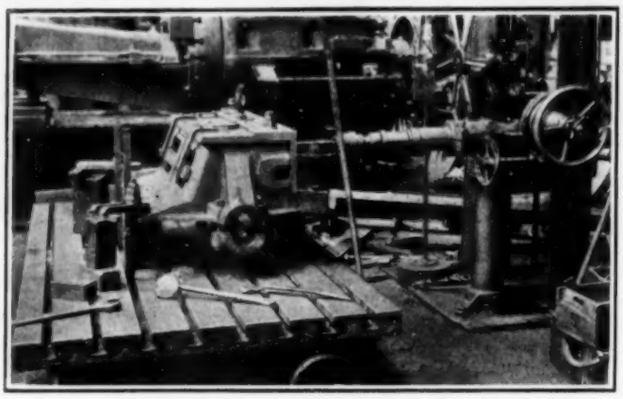


Fig. 5—Drilling crankcase

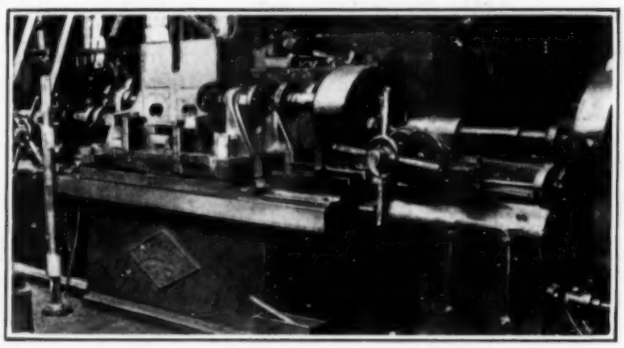


Fig. 6—Boring camshaft and main bearing holes

Harnischfeger horizontal boring and drilling machine. The machine is attached to a column so that it can be raised or lowered, and the work is clamped to a table that runs on a track. The job is to drill twenty-four 31/32-in. holes through the wall of the piece, which is ⅝ in. thick. The drill runs at 300 r.p.m., feeding 3½ in. per min., and the piece is finished complete in one hour.

The operation of boring and reaming the main bearing and two camshaft bearing holes in a crankcase is illustrated in Fig. 6. The machine is a Rockford horizontal drilling and boring machine and is equipped with a geared head that elevates the camshaft boring-spindle bars to the proper position and makes it possible to bore both camshaft holes at the same time. The camshaft boring bars are operated from one end of the machine and the main bearings are bored from the other end, the three boring bars working simultaneously. One of the bars can be seen standing beside the machine. The camshaft boring bars operate at a speed of 60 r.p.m., while the main-bearing boring bar revolves at a speed of 40 r.p.m., all bars feeding 0.020 in. per revolution. Two cuts are taken through each

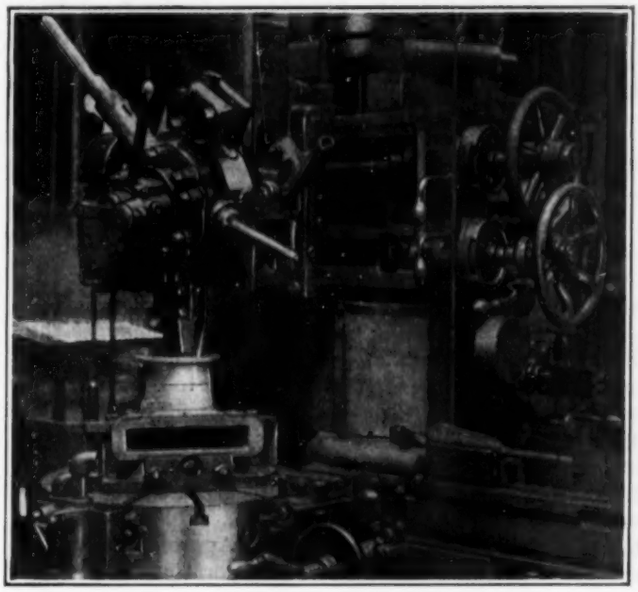


Fig. 7—Machining pump gear case

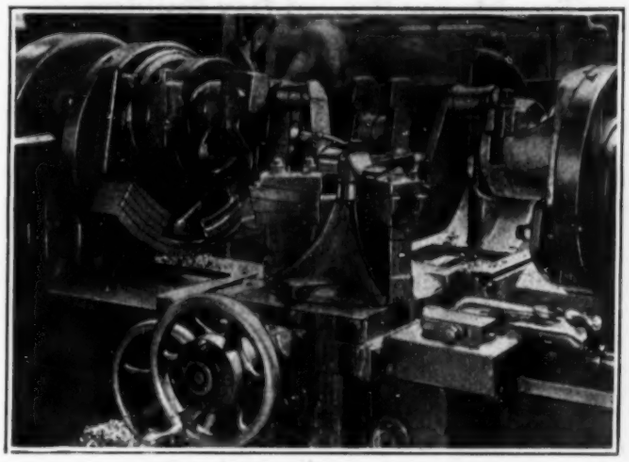


Fig. 8—Turning tractor crankpins

hole, approximately ⅛ in. of stock being removed in the first cut, and 0.010 in. in the second. A production of 22 cylinder blocks per day is maintained without undue effort on the part of the operator.

The turning and boring operation on a cast-iron pump gear case is shown in Fig. 7. The machine is a Bullard vertical lathe and the tools are made of ¾x1¼-in. Rex AA high-speed steel. The case is bored, the pumpshaft hole is bored and reamed, and the flange is turned and faced, leaving a shoulder by which the piece is located when it is assembled to the engine, the entire operation taking 45 minutes.

The illustration Fig. 8, shows the operation of rough turning the pins on a crankshaft for a four-cylinder tractor engine, using a LeBlond crankshaft lathe for the job. The piece revolves at a speed of 90 r.p.m., while the tools are fed in by hand. Approximately ⅛ in. of stock is removed, the drawing dimensions being 2.375 in., with an allowance of plus 0.010 in. If the operator has no trouble, a shaft can be turned out complete in 15 min., although 20 per day is considered a fair production.

The operation of grinding the cams on a camshaft for a 6¼x8-in. four-cylinder engine is shown in Fig. 9. The machine is a Norton grinder, using a 24 combination K Norton wheel, size 2½x20x5 in., running at a speed of 1,750 r.p.m. The cast-iron casing that can be seen on the left end of the table of the machine

Fig. 9—Grinding cams

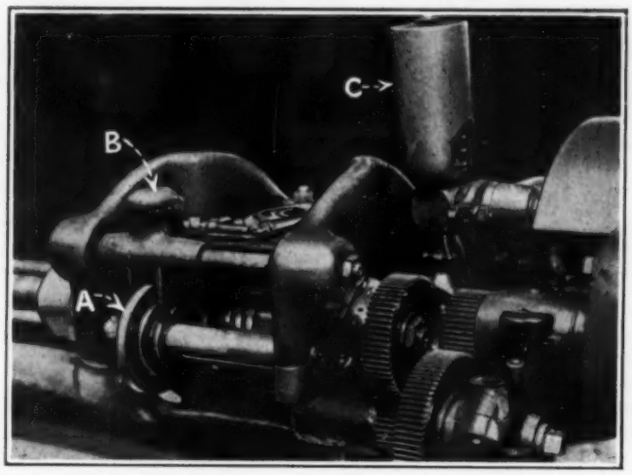


Fig. 10—Master cams and operating mechanism

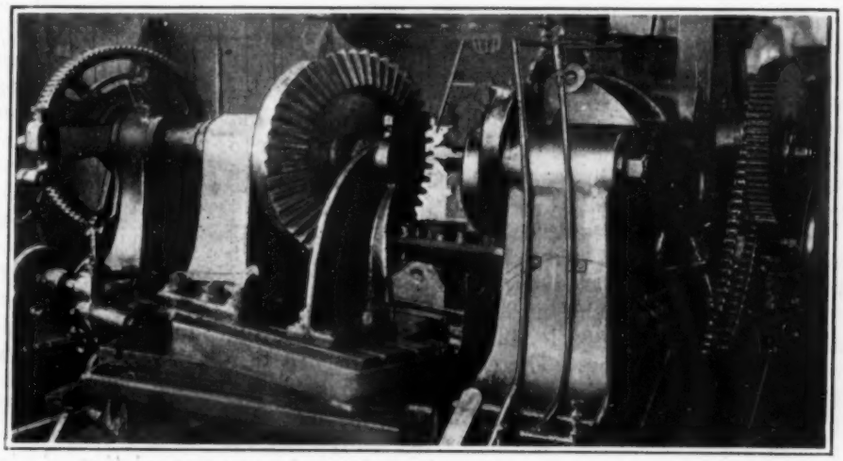


Fig. 11—Planing teeth on bevel drive gears

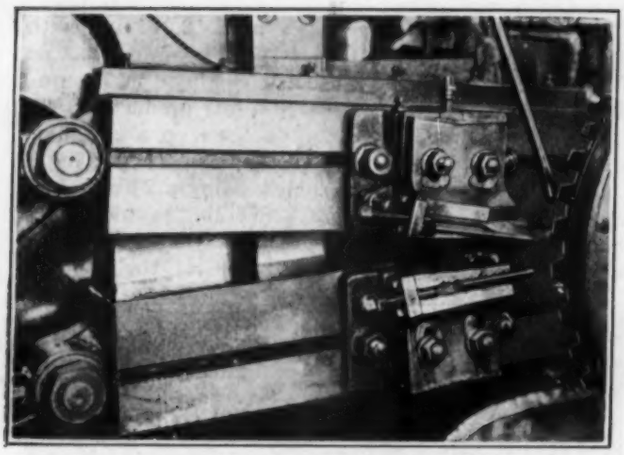


Fig. 12—Cutters and manner of holding

covers the mechanism shown in Fig. 10, which governs the shape of each of the cams. A set of eight master cams is mounted on a shaft integral with the mechanism that carries the centers upon which the camshaft is

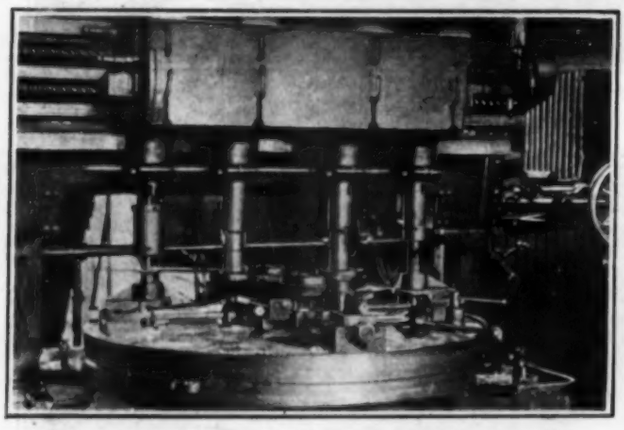


Fig. 13—Drilling and boring connecting rods

mounted. A master cam roller *A* is mounted on a shaft in such a manner that the roller is at all times in contact with one of the cams, the selection being determined by means of the shifter *B*, which slides on its shaft. A pin in the shifter drops into a corresponding hole directly over the selected cam and locks the roller in the desired location. As the cam with which the roller is in contact revolves, the center swings, carrying the camshaft centers with it, so that the grinding wheel will produce, on the work, the contour of the master cam. The master cam is held against the roller by the action of a heavy spring in the cylinder *C*. The cams are approximately 3 in. in diameter through the round part in the rough, and are reduced in this operation to approximately 2.570 in., a production of seven shafts per day being obtained.

The bevel drive gears used in the Twin City tractors are of cast steel and are cut on the machine shown in Fig. 11, which is a bevel gear planer made by the Robey-Smith Co., Manchester, England. The gear shown in the machine is 24.368 in. in diameter, with 48, 2-P. teeth, each 4½ in. long. The cutters are formed to a gage and are set as shown in Fig. 12, each being set to plane one side of the tooth. Each cutter is held on a separate slide so that it can be set at the correct angle, the slides alternating when in action. A gear of the size shown in the illustration is cut from the solid in one cut, the operation requiring approximately four hours. Smaller gears, which are finished afterward on another machine, can be roughed out at the rate of four per hour.

A Moline "Hole Hog" in process of drilling and boring the holes in the ends of drop forged steel connecting rods for tractor engines is shown in Fig. 13. The rods are 12 in. long between holes, center to center. The machine is built with a rotary table and four spindles, two for the roughing and two for the finishing operations. The machine rough drills one rod while another is in process of finishing, and the operator changes the pieces at a third station at the same time. The hole in the small end of the rod is drilled to 1$\frac{13}{16}$ in., and is finished with a 1$\frac{7}{8}$-in. boring tool. The limit is 0.001 in. The large end of the rod is rough bored to leave $\frac{1}{16}$ in. for finishing, and then finish-bored to 2.720-2.722 in. The speed of the tools for finishing the small end of the rod is 88 r.p.m., while the tools for the large hole make 54 r.p.m. Approximately 125 rods per day can be drilled on this operation.

Trouble for Present-Day Builders

BY CHESTER LYNNDELLE

The unsigned article "Trouble for Future Archæologists," appearing on page 590, Vol. 60, of the *American Machinist*, makes me wonder where the architects were all the time the contractors were putting pipe into concrete for reinforcing.

In the spring of 1905 the writer chanced to be where he could observe the construction of a four-story light manufacturing building of concrete construction, in which the contractor used pipe in place of solid reinforcing bars, and even used condemned cable (steel hoisting cable) as reinforcement in arches and for floor sections.

Being interested in concrete construction, I watched the work carefully, and saw that the mix was well up to standard, the batches well mixed and tamped, and when the building was completed it looked like a real job; but within two years cracks began to develop, arches sagged and cracked badly, and the safe loading was reduced by fifty per cent before the two upper floors could be used.

Finally, two years ago, the building was torn down and again I chanced to be on the ground. In practically every case where partial failure was evidenced by cracks and sagging, the reinforcing material (pipe or cable) had rusted away. Pipes were mere shells of rust, with no more tensile strength than so much dry sand; and sections of the cable could be pulled through the concrete. There was apparently no bond or adhesion between concrete and the cable, or, if it had been bonded, rust of the cable had loosened it.

From the showing made by this building, it would have been satisfactory had the designer figured his sections for *un*reinforced concrete, but he computed the thicknesses to call for reinforcing, while the pipe used proved a weakness rather than a strengthener; robbing the section of its cross-section area instead of adding that much steel.

This is being forwarded you because some readers might take the above-mentioned article as a recommendation of pipe for reinforcing.

A Workable Production Control System

By Edward Davis
Production Manager, Edison Phonograph Works

Plans and procedure for shop orders and shipping schedules—The production control board—How the system is installed—Delayed and advance shipments

A SHOP order is used principally as a production order to the department that performs the first operation on bar or sheet stock. The necessary data for these orders are obtained from the part record cards and the raw material control sheets. We have previously noted that the raw material control sheets are gone over once each month. At this time, wherever the work-in-process line indicates that a shop order is required, the necessary information is taken from the part record card and the shop order is typed and issued to the proper department. The work-in-process line is continued to indicate the period covered by the shop order to be issued.

Copies of this shop order are sent to the department head, the department stockkeeper, the chief storekeeper, raw material stores, the chief inspector, the accountant, and one copy is filed. Upon the receipt of a shop order the department head will make note of the conditions in the department, and ascertain from the stockkeeper what amount of these parts is still in stock and available for shipment. These two factors determine accurately the time available in which to set up machines and turn out a sufficient quantity of parts.

To guard against the possibility of the production department failing to issue a shop order on time, the department stockkeeper will notify the chief storekeeper when his stock has reached a minimum and a memorandum will be sent to the production department. This memorandum contains an accounting of all the work in process in the various departments, as taken from the perpetual inventory, and serves also as a check for the raw material control sheet, the production control board, and the master control sheet in the production department office.

The copy of the shop order sent to the raw material stores serves as a requisition and, as soon as it is received, the material is weighed out and delivered to the department without any further notification being necessary.

The copy to the chief inspector serves as a notice to him that work is about to be started on a new lot of parts and gives him an opportunity to issue to his assistants any special instructions that may be necessary. All copies except those for the accountant and chief inspector are returned to the production department when work is completed, the raw material stock copy being returned almost at once with a notation that the stock has been delivered.

In the event that a department is unable to make the number of pieces required from the amount of stock supplied, the department superintendent sends a requisition to the works manager's office before breaking the set-up. This requisition states the amount of stock required, the amount of good pieces produced, the scrap if any, and the total of the latter two. Such requisitions are immediately investigated, the blueprints are gone over to check the cut-off specified with the cut-off used, and if any discrepancy is found the material required to complete the shop order is delivered to the department. The blueprint is corrected, if wrong, or the department superintendent is expected to explain the loss if the data are correct. An overproduction is checked by information obtained from closed shop orders, and the blueprints and the raw material control sheets are changed if found incorrect. This procedure gives an automatic check of the amount

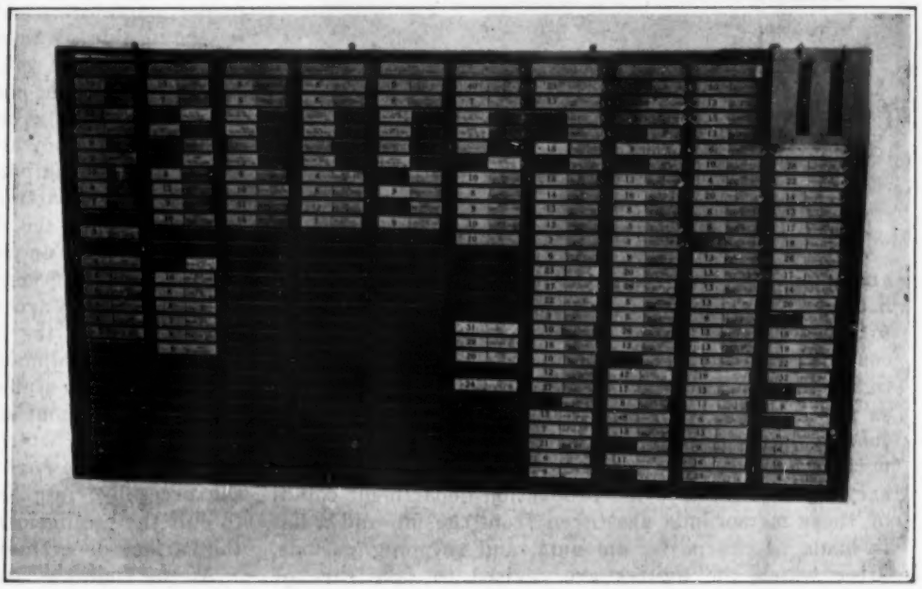


Fig. 13—Production control board showing delayed and advance shipments recorded

This is the third article of the series. The second article was concluded on page 838, Vol. 60, No. 23.

of parts produced from a given amount of material and the raw material control sheets soon become reliable records of actual performance and of work in process.

The next step in the ordering of production work in the shop is to schedule the shipments of parts made on the above shop order, so as to guarantee an even, uniform flow through the shop. At the time the shop order is made out, reference to the part record card shows what other departments, if any, are to perform subsequent operations, and a memorandum is sent to each of these departments, calling for daily, weekly or monthly shipments. The determination of the shipment periods

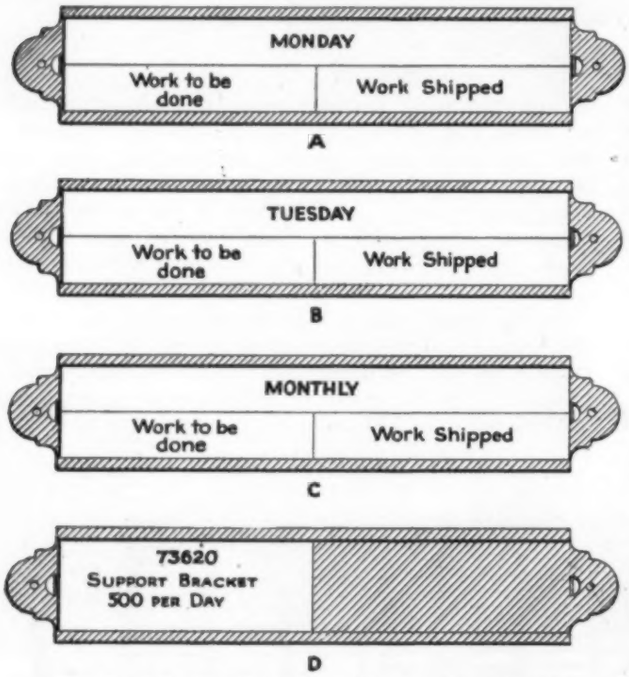


Fig. 14—Control board headings and part card

and quantities was explained in the preceding article.

Copies of shipping schedule memoranda are sent to the department head, the chief storekeeper and the control board inspector, it being the duty of the latter to see that the cards are properly set up in the boards, as will be explained later. These shipping memoranda constitute the basis for production schedules in the various departments and changes are sometimes necessary. At such times the production department copies of these memoranda are taken from the file and a list is made of the parts, amounts, and shipping periods, after which the figures are revised to take care of production requirements and new schedules are issued to each department.

Eventually memoranda are issued for addition to schedule only, for when a new schedule is issued, all parts started by memoranda since the previous schedule was issued are embodied in the new schedule. The new schedule automatically cancels all previous schedules and memoranda. In order to facilitate the handling of schedules, they are divided into three classes, disk, amberola and business, so that a change in the sales requirements of any one does not make it necessary to go over all three.

There is one exception to the above routine. When small quantities are required, copies of the shop order are sent to all of the departments that operate on the part and, in this case, shipments of the entire quantity are made from each department.

The production control board has been mentioned in a previous article, but it is of such importance in the proper operation of this system that it will be well to consider its use in detail. One of these boards is illustrated in Fig. 13, and each manufacturing department has from one to three boards, depending on the number of individual parts shipped. The commercial stores is also provided with a board for checking its shipments into the factory.

The boards are all of uniform size and design and nine columns of small metal card holders are attached to the face of each board, each column having 28 holders. The first six columns are for the six days of the week, the remaining columns being used for other than daily shipments. The top card holders in the first and second columns contain column heading cards as shown at *A* and *B*, Fig. 14, the remainder of the first six columns being headed by similar cards designating the day of the week that the column represents. The other columns are headed as shown at *C*, Fig. 14, when used for monthly shipments.

How the Part Cards Are Placed

When a shipping schedule or memorandum is received in a department, the department stockkeeper places a card, bearing the part number, the part name and quantity to be shipped, in a vacant card holder in the proper column. This card is half the length of the holder, as shown at *D* in Fig. 14, and is placed at the left-hand side of the holder under the heading "Work to be Done." If the part is to be shipped daily six cards are made out and inserted in the first six columns. There are usually comparatively few of these daily shipments and they are grouped at the top of the board.

When weekly shipments are required, the stockkeeper consults the department superintendent, and the card is placed under the day of the week most convenient for shipment. For monthly shipping periods the cards are placed in the last columns. As the shipments are made, the cards are moved from left to right in the holders so that the board will show at a glance the status of the shipments in the department.

I have already stated that this system can be installed at any time without affecting the operation of the plant. The method in which this is done can be shown by taking a specific part as an example, following through the procedure in planning the production of the part to suit the requirements and in controlling the work of the various departments to suit the plan.

At the time the original memoranda are sent out to start the system, the amount of stock in each department is considered. An allowance for a reasonable amount of work in process, depending upon the operations performed in each department and the rate of production on each operation, is then made and each department is notified of the date on which it is to make the first shipment.

For example, let us consider the support bracket No. 73620, shown in Fig. 15 in the rough and finished state. The requirements are 11,000 per month, or 500 per day, and we will assume that this part has not been made since the control has been started. The stockkeeper in the final assembly department finds that the stock of this part is getting low, and immediately notifies the chief storekeeper who consults his inventory

cards and sends a memorandum to the production department as follows:

Production Manager:
Subject: Part No. 73620—Support Bracket Inventory

Mechanism Assembly Department	7,500
Drill Press Department	3,500
Polish & Buff Department	7,000
Total	18,000

(Signed) .....
Chief Storekeeper

This memorandum gives the production department an inventory of the work in process, and by communicating with the casting stores it is found that there are 6,300 castings in stock. The total available stock is, therefore, 18,000 in work in process plus 6,300 in casting stores, which makes 24,300 pieces or 48 days' supply. The part in question is a standard part for which there is a constant demand, so that a work-in-process allowance for each department involved is necessary and these allowances are then worked out.

The operations in the polish and buff department are such that a week's supply of 2,750 pieces can be finished in a few hours and, as all castings are inspected when received in the casting stores, there is very little possibility of rejections. Therefore, one week's requirement is ample for the work-in-process allowance. In the drill press department there are several operations and rejections are possible, so that a two weeks' allowance for work in process is made. As this particular casting is furnished by a local foundry and a supply can be obtained in less than two weeks, a two weeks' work-in-process allowance is made to the casting stores. The stock on hand and the various allowances can now be tabulated.

Department	On Hand	Work-in-process Allowance
Casting stores	6,300	2 weeks or 5,500
Polish and buff	7,000	1 week or 2,750
Drill press	3,500	2 weeks or 5,500
Mechanism assembly	7,500	2 weeks or 5,500
Total	24,300	19,250

Deducting the 19,250 work-in-process allowance from the 24,300 pieces on hand, we find 5,050 pieces available for schedule purposes. Let us suppose that the notification from the chief storekeeper was received on Tuesday, December 4, 1923. An analysis of the tabulated data above shows that the mechanism assembly department will require a shipment in four days, December 8; the drill press department should receive a shipment at once, December 4; and the polish and buff department must have a shipment on Thursday, December 13. The production memorandum will then read as follows:

Casting Stores,
Polish and Buff,
Drill Press Dept.:
Subject: No. 73620—Support Bracket

Add the above part to your production schedule and ship as follows:

Casting stores.....2,750 per week beginning December 13
Polish and buff dept.....500 per day beginning December 4
Drill press dept. .....500 per day beginning December 8

Copies to General Supt., Chief Inspector, Chief Storekeeper, Polish and Buff Stock, Drill Press Stock and File.

When the stockkeeper in the casting stores receives his copy, he immediately puts a card on the production control board under Thursday, the stockkeepers in the other two departments placing a card in each of the daily columns as shown at *D*, Fig. 14. The stockkeeper in the polish and buff department, as soon as he sets the cards in the board, moves the card located under Monday to the right, signifying that the shipment for that day has been made, because Tuesday, December 4, is the date on which the first shipment on the new schedule is to be made.

The board in that department is now set up and, since the day on which it is done is Tuesday, December 4, he ships 500 parts to the drill press department and moves the Tuesday card to the right. The drill press stockkeeper, in setting up his board, moves all but the last or Saturday card to the right, thus indicating that the Saturday shipment is the next one to be made. Then on Saturday, December, 8, he ships 250 pieces and moves that card to the right. Every Monday morning all of the cards are moved to the left, ready for that week's shipments.

In order to simplify the production control system, the year is divided into 52 periods of 5½ days each, and

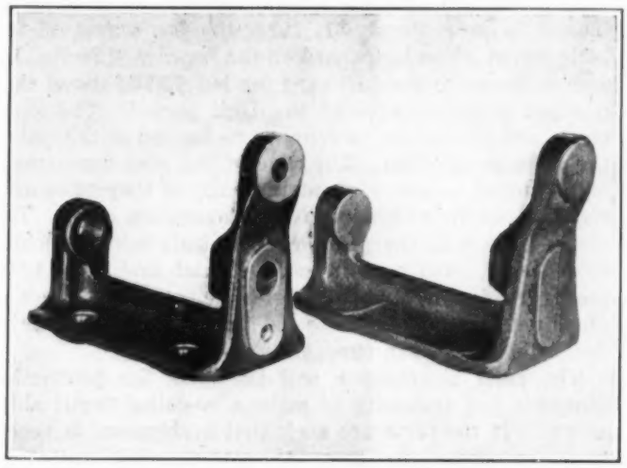


Fig. 15—No. 73,620 support bracket

each department stockkeeper is supplied with a set of 4x4-in. cards numbered from 1 to 52. One of these cards is hung on a hook on or near the production control board, and designates the current weekly production period, as shown at the upper right-hand corner of the board in Fig. 13. A number of sets of small cards, ¾x1½ in., numbered the same way, are also supplied and can be seen in the card holders. The small cards are used for delayed or advance shipments.

For example, the drill press department stockkeeper may be unable to make the shipment on Saturday, December 8. On Monday, December 10, he will rearrange his board to take care of the week's shipments and, as December 10 starts and December 15 ends the 50th period of 1923, he replaces the 4x4-in. card bearing the figure 49 with a card numbered 50. On No. 73620 he leaves the small part cards as they were and puts a small card bearing the number 49 at the left of the part card, thereby recording the fact that 250 pieces are due in order to complete the 49th period. This constitutes the record for a delayed shipment. When the schedule calls for a shipment every four to twelve weeks to provide for economic operation on small parts, the department will of course ship an amount of stock more than sufficient to cover the current weekly period and, in order to keep account of these shipments on the production control board without confusion or

reference to other records, a number card is placed in the metal card holder to the left of the part card, showing the period covered by the latest shipment.

For example, the drill press department schedule may call for a shipment of 3,000 of part No. 72,750 pulley clutch, every twelve weeks. If the control board shows that the last shipment covered the period ending with the 50th week and the 3,000 parts for the next shipment are all ready, the stockkeeper makes out an inter-departmental shipping ticket and places the work at the delivery station. Card 50 is then taken from the metal holder containing part card No. 72,750, and a 10 is put in its place, showing that enough of part No. 72,750 has been shipped to take care of the next department at the current schedule until the end of the 10th period of the next year. The next shipment is now due on March 8, 1924, and is so recorded by this procedure.

Delayed Shipment Procedure

To carry this example a little further, let us suppose that it is now March 31, 1924, the beginning of the 14th period. The large card on the board will be No. 14, and reference to the part card for No. 72,750 shows that the last shipment covered the 10th period. The shipments will, therefore, be four weeks behind at the end of the week in question. The head of the next department is beginning to worry about the part, as they have only eight weeks in which to do their operation on it. The stockkeeper will, therefore, communicate with the chief storekeeper, who may investigate and find only 1,500 pieces ready in the drill press department, since a machine break-down made it impossible for them to finish the balance in time.

The chief storekeeper will then ask the production manager for authority to make a so-called "split shipment." If the facts are such that a shipment is necessary in order to keep things running smoothly, permission is accordingly given to ship 1,500 pieces, or six weeks' scheduled supply, and a special report is made. In the meantime the stockkeeper puts a small 16 card in the card-holder in place of the 10. These reports are discussed at weekly meetings, a thorough inquiry being made into all of the circumstances surrounding the affair, and it might be stated here that these so-called split shipments do not average more than three per week.

Conditions Determine Next Shipments

If the work in the drill press department is resumed in time to allow the balance of 1,500 clutches to be completed and shipped to the next department before they have completed their operation on the first 1,500, the stockkeeper ships the 1,500 pieces. If, on the other hand, the work is not completed in time, it is held until 4,500 pieces are available and then shipped to the next department in one lot. The reason for holding the second 1,500 and bringing them through with the next regular shipment of 3,000 pieces, is that 3,000 pieces make an economic quantity on which to operate. We have already made one uneconomic set-up of the first 1,500 pieces, and naturally do not want to make another, unless it is absolutely necessary.

It is, of course, understood that in the event of a serious break-down more than one split shipment must be made on a part. This class of shipment, however, has been reduced to a minimum.

Book Reviews

Handling Callers in the Business Office. By Helen Hysell. One hundred and six 5x7-in. pages. No illustrations. Published by "The Purchasing Agent," 53 Park Place, New York City. Price $1.50.

An excellent book, upon a subject too long neglected and the importance of which is not yet fully appreciated, written by one who displays familiarity with the problems involved.

Written by a woman, of a position that is generally held by women, the feminine pronoun naturally predominates; but, as this author makes clear, the job calls for the exercise of tact, diplomacy and discrimination hardly second to that of the president of the concern, and the incumbent should be chosen for other reasons than that she is able to operate a telephone switchboard, is "easy to look at" and is willing to work for an entirely inadequate salary.

That elusive and intangible, though important, asset, good will, is very largely in the hands of the reception clerk. He or she stands to the visible portion of the firm's constituency in much the same light as does the person who answers the mail inquiries to that part which conducts its business by correspondence. Each is, for the time being, "the Company," and no business house can afford to maintain in either position a person who, through ignorance, incompetence or willful lack of interest, is capable of conveying a false impression of its standing.

The Engineering Index for 1923. 700 pages 6½x9¼ in. Published by the American Society of Mechanical Engineers, New York, N. Y. Price to members $6 and to non-members $7.

Although the indexing of engineering periodicals began in 1884 this is the fifth volume to be issued by the American Society of Mechanical Engineers. It is somewhat larger than the last and has been slightly changed to make it easier for the eye to catch the main headings. Several hundred periodicals, reports and other publications are reviewed, there being approximately 12,000 brief notices of articles in addition to numerous cross references. It is obviously impossible for any review of the volume to give an adequate idea as to its contents. Engineers and others who desire to keep posted on material which has been published along any particular line can do so more easily by referring to this index than in any other way.

The Modern Foreman. By Robert Grimshaw. 297 pages, 6x9 in. Published by Gregg Publishing Co., New York, N. Y. Price $2.50.

This is a revised edition of the book previously reviewed. The fact that a second edition is necessary is we hope, a sign that industry is awakening to the necessity for modern foremen.

The book is divided into 20 chapters in which the various duties and qualifications for foremen and the principles of production are discussed in a very readable manner. It deals with efficiency, factors in production, workers and foremen of different kinds, selection and promotion, personality, leadership, training, welfare, morale, etc. Factory methods and foremen's duties also receive attention and much sound advice is to be found in the pages of the book.

Close Work on a Cast Iron Bushing

By Douglas T. Hamilton
The Fellows Gear Shaper Co.

Accurate guide bushing for gear shaper spindle—Tolerance of 0.0002 in. in the bore—Unsuccessful methods—Grinding operations finally satisfactory

THE guide bushing, shown in the rough and finished state in Fig. 1, is of comparatively insignificant appearance, but it performs an important function in our high-speed gear shaper and has presented an interesting problem in interchangeable manufacture. This bushing, which is held in the lower portion of the saddle of the gear shaper, aligns and guides the cutter-spindle, upon which it must have an extremely close fit. The cutter-spindle is made from alloy steel, heat treated, hardened, and ground all over, the portion that operates in the bushing being ground to very close limits and highly polished. The maximum tolerance on both bushing and spindle is 0.0002 in., so it is evident that these two members require very close machining to give satisfactory results.

A broken section of one of these bushings is shown in Fig. 2 and illustrates the chilling effect obtained by casting in an iron mold, together with a resultant refinement of grain that gives good wearing qualities. The test made to prove the alignment of the bushing with the guide casing seat in the saddle is illustrated in Fig. 3. To make this test a cutter spindle is inserted in the bushing, which has previously been forced into the saddle, and a dial indicator is attached to the upper end of the spindle. The spindle is then rotated with the indicator pointer or plunger bearing against the bored surface as shown. The bushing must hold the spindle in alignment with this bore with a maximum misalignment of 0.0015 in. in 14 in. length.

The bushing is now made from a close-grained cast iron of special analysis, and has been machined in a variety of ways. As previously mentioned, it is cast in an iron mold with a sand core, the resulting casting being chilled from the outside in. The operation layout for the first method of machining tried was as follows:

1—Anneal after casting.

2—Bore, face, chamfer and turn one-half the length in a turret lathe.

3—Reverse in chuck in turret lathe, and complete turning.

4—Rough and finish grind one end, reverse, and finish grind the other end on a Blanchard vertical surface grinder.

5—Rough grind external diameter to within 0.010 in. of finished size on a cylindrical grinding machine, holding the bushing on an arbor.

6—Finish grind in a similar manner to within 0.0004 to 0.0006 in. of nominal size to obtain a light drive fit in the hole in the saddle.

7—Grind the bore in an internal grinding machine, holding the bushing in a jig of the same size as the hole in the saddle. (The hole was first rough ground, then without removing the bushing the wheel was dressed, after which the hole was finish ground to a tolerance of plus or minus 0.0002 in.)

After the bushings that were machined in the foregoing manner had remained in stock for some time, it was found that distortion had taken place. Some were

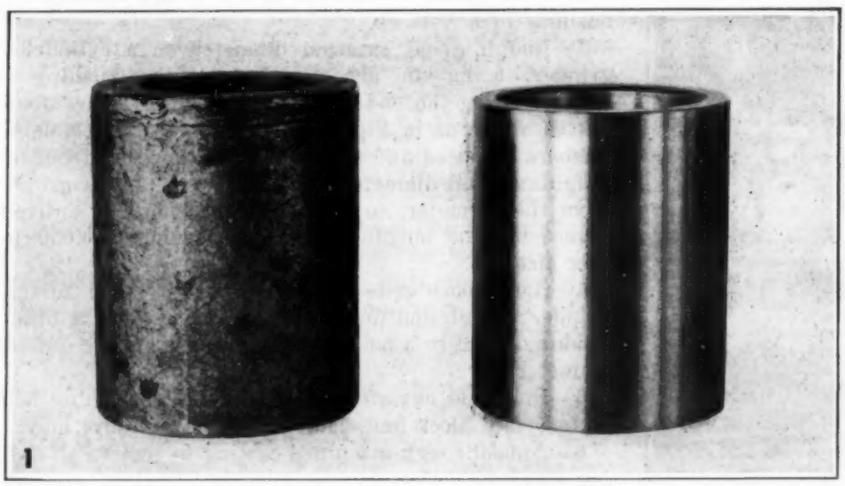


Fig. 1—Rough chilled casting and finished bushing. Fig. 2—Broken section of bushing showing grain density from chilling

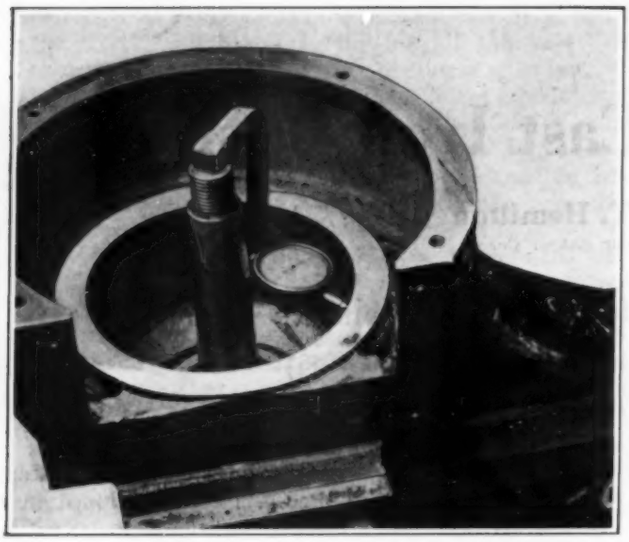


Fig. 3—Bushing under test in the saddle

oval in shape; others were tapered; and those which were apparently round and straight showed a three-point bearing when assembled in the machine. In some these projections were so slight that a few hours of running produced practically a full bearing; in others the points were so high that the bearings had to be scraped. It was found that these high bearing points were exactly in line with the positions occupied by the jaws of the three-jaw chuck of the turret lathe used in the preliminary machining operations. Rejections amounted in most lots to over 50 per cent.

Before the second method was put into practice, it was found necessary to reduce the tolerance on the hole of this bushing from ±0.0002 in. to +0.0002 in., and this change did not, of course, simplify matters any. The same methods of machining were followed up to the point where the bushing was rough ground—operation 5. This time the bushing was rough ground to within 0.015 in. of the finished size and put away to season. The outside diameter was then finish ground, and the bushing was finished in the hole as previously outlined.

After this procedure careful inspection indicated some improvement, but it was still found that the bushings remaining in stock for some time were distorted. An inspection of the castings as they came from the foundry was then made, revealing the fact that in some cases the core had been set off center, making the walls of the bushing uneven in thickness. A few of these irregular castings were selected, carefully machined, and then put away to season. Subsequent inspection showed that every one of them was distorted, indicating that the unequal density of the casting was largely responsible for the resultant distortion.

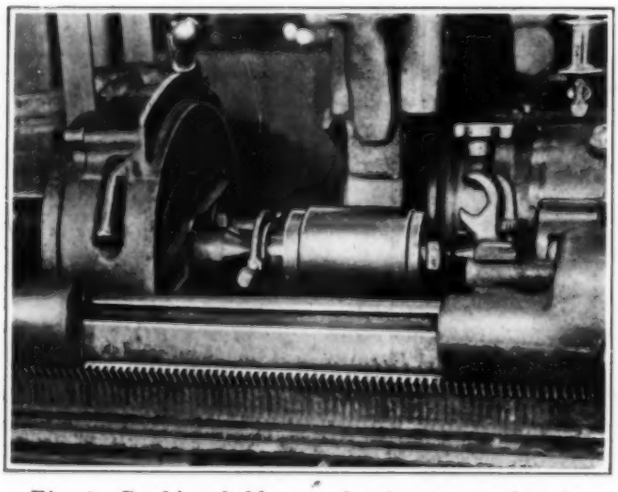


Fig. 4—Bushing held on a floating type arbor for rough grinding outside diameter

The above experiments disclosed the necessity of a careful inspection of the rough castings prior to machining, and a tolerance of $\frac{1}{32}$ in. was allowed for eccentricity of the hole with the external diameter. The machining operation layout was also changed, and the annealing was done after instead of before the machining. The final operation layout is as follows:

1—Inspect rough castings for concentricity of bore with external diameter—maximum eccentricity $\frac{1}{32}$ in.

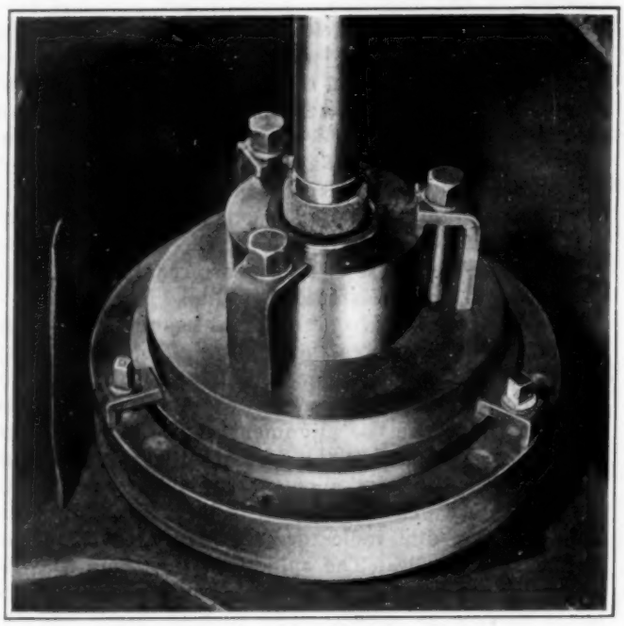


Fig. 5—Finish grinding in the bore

2—Disk grind one end from the rough holding the bushing in a V-block.

3—Rough grind external diameter on a cylindrical grinder, using an arbor on which the bushing is clamped from the ends only and allowing it to "float" on the arbor, as in Fig. 4. Two $\frac{1}{4}$-in. rubber clamping washers are used and the bushing is trued up from the rough external diameter. From $\frac{1}{16}$ to $\frac{3}{32}$ in. is ground from the diameter, so that the double chill is entirely removed. The bushing is rough ground to 0.050 in. over size.

4—Grind both ends on a Blanchard vertical surface grinder; rough and finish one end and finish the other. Bushings held in a pot jig and located from the outside diameter.

5—Bore and chamfer in turret lathe. Bushing held in faceplate block and clamped by end pressure only.

6—Anneal rough-machined casting to remove all casting strains.

7—Grind external diameter to fit internal grinding jig.

8—Grind hole in internal grinder. For this operation, the bushing is forced into a jig in which it has a light force fit and is not clamped, as illustrated in Fig. 5.

9—Finish grind outside diameter, holding bushing on an arbor which is a good fit for the hole, but upon which the work is clamped by end pressure.

By this method of machining rejections were cut down to less than 10 per cent, even with the reduced tolerance in the diameter of the hole. Much better service was also obtained. It will be noticed that the main factors leading to satisfactory results were, first, exclusion of castings with eccentric cored holes caused by unevenness in density of material; second, annealing after rough machining to remove the casting strains held in check by the double chilled surface; third, the elimination of all chucking methods that exerted an unevenly distributed pressure on the work during machining, and clamping from the ends instead of on the external diameter for all machining operations.

It will be interesting to know how long these bushings will stand up. High-speed gear shapers equipped with such bearings have been in constant use for over two years working at 600 strokes per minute. There has apparently been no appreciable wear, as it has not been found necessary to replace any of them. It might also be mentioned that when the machine is completely assembled, it is put on a test stand and run in under a constant stream of oil for six hours, operating at the full stroke of 1¼ in. and at 600 strokes per minute. Bushings that have been examined after the running-in, have shown a remarkably glass-like surface, and an almost perfect bearing. It was only by giving the closest attention to all of the details of manufacture and assembly that satisfactory results have been obtained.

British Machine-Tool Design

By W. E. Sykes

A CREDITABLE number of British machine tools of recent design are well worth careful study by all engaged in the metal working industries. The most striking feature of the English lathes is probably the gap bed. British lathe manufacturers are at present advertising this type of bed almost exclusively. Until recently the gap bed was considered desirable for jobbing shops only, but now it appears greatly in favor among all users. As at present designed, it does not seem to weaken the bed nor to prove disadvantageous in any way. Its advantages are obvious. A 17-in. lathe will swing in the gap work 30½ in. in diameter and 10 in. wide. This enables it to do a great variety of work which cannot be handled by a lathe of the same size having a straight bed. If the gap-bed lathe has no drawbacks, why not use it and thus have its advantages available whenever they may be required? It has a better second-hand market because it is more useful in the jobbing shop. The makers find it sells better in the colonies and in other sparsely populated countries. Gap-bed lathes are now called standard. Straight-bed lathes are special.

The development of automatic lathes of various sizes and for a wide variety of work has absorbed much energy during the last five years. Automatic bar or screw machines have received close attention and machines adapted for automatically turning work held in a chuck are available in a sufficient quantity to meet present demands.

Scots Dislike Boring Mills

Boring mills are extensively used in England, but it is surprising to find a disinclination to use them in Scotland, especially in the Clyde shipyards where large faceplate lathes are preferred. In a large engine works of world-wide repute the author saw some awkward work being done in one of these large lathes, and suggested to the manager the use of a boring mill. The suggestion was promptly rejected, and it was explained that a large turning mill had been installed and tried out, but found quite unsatisfactory. This was both surprising and interesting. It serves to show that local habits or prejudice can easily prevent a machine of great utility from receiving the patronage which it rightly deserves.

Besides the conventional two-column cross-rail type of planer, a large variety of other types are made, the order of popularity being approximately as follows: The single-column type carrying a horizontal arm—known as the open-side type; the side planer, in which the work is stationary and the tools reciprocate, being carried by one or more saddles which have an overhanging arm; and the single-column type, in which the tool saddle is carried on a vertical slide.

In addition, there are a number of plate-edge planers and a special pit planer, which latter has a fixed table and a large traveling bridge supported and guided by beds on each side of the work. This machine is used in shipbuilding work for machining heavy castings.

Electric Planer Drives

The features of most general interest in connection with the conventional type is the electrical equipment and the modification of mechanism due to the adoption of reversible variable-speed motors. Direct-coupled motors are nearly always used for machines over 4 ft. wide. Many old machines have been altered from belt to motor drive.

The side planer is largely used in Great Britain. The usual speeds are 40 ft. per min. cutting and 150 ft. per min. return. Its purchase involves a small capital outlay in comparison with the wide range of work which it can handle.

The carriage is propelled to and fro by a chain driven by sprockets. This feature is very interesting as applied to a modern machine because, according to history and an example in the South Kensington Museum, London, England, the first planing machine had a chain-driven table. The chain used in the present-day machine is, however, very different from that in the ancient example.

A careful study of present designs shows the following tendencies toward improvement: Ease of operation without reducing either strength or rigidity; greater accuracy, both initial and permanent; the use of higher-quality materials; elimination of belts and countershafts; more efficient and additional safety devices; automatic lubrication and the elimination of oil and grease; the development of automatic mechanisms and the better finish and neater appearance.

Extracts from paper read at the Spring Meeting of the American Society of Mechanical Engineers, Cleveland, Ohio, May 26 to 29, 1924.

The Old Time, All Around Machinist—Discussion

By F. A. Chase

THERE was published on page 47, Vol. 60, of the *American Machinist*, an article by F. M. A'Hearn under the title given above, in which he speaks of old timers away back in the nineties. I think at that time there were very few who could properly be called old timers, as nearly everything was then modern. As I look at it, only those who were in the mechanical business as early as 1850-1860 are really old timers. All the machinists, apprentices and higher-ups that I remember having worked with or worked for, were what you could call good all around mechanics. As a rule, the apprentices served five years and there were no "dubs" among them.

F. A. Chase

While I do not wish to advertise myself, I will state that I served my time in the machine shop at Windsor, Vt., between the years 1852 and 1856. Our pay for the first year was 40 cents a day of 10 hr. and the very best machinists got only $1.75 for a day of the same length. We did not have all kinds of fine tools to work with. We had to make our own tools from the rough, and in many cases to forge, finish and temper them. We also had to make our own machines of every kind. We had to know something about gearing, as we not only cut our own gears, but made the cutters to shape the teeth. All our drills, taps, dies, reamers, etc., were home-made, and the taps were cleared by filing the tops, bottoms and sides of the threads nearly to the cutting edges.

Among the men and boys who worked in the shop in the fifties were: Henry Dunbar, who later invented the Dunbar packing and who, for thirty-five years, took engines to all parts of the world for the Baldwin Locomotive Works; George D. Kenson, who made the tools for the Elgin Watch Co.; Samuel Porter, who was superintendent of the Springfield Armory for many years; Charles E. Billings, of the Billings & Spencer Co.; Thomas Place, master mechanic of the Illinois Central Railroad in Iowa for sixty years. And there were a great many more who made good and of whom I have lost track.

Late in 1856, I went to the Detroit Locomotive Works, and with George Tilton (later superintendent of motive power C. & N. W. road) erected the right-hand sides of four engines for the New York Central, four for the C. B. & Q., and twelve for the Michigan Central. Andrew Farrer, who worked near us, went to the Northern Pacific as superintendent of motive power. Charles Foster, another machinist, went to the Fremont, Elkhorn & Missouri Valley Railroad as master mechanic. These men were from Manchester, N. H., and were old timers. I have mentioned those whom I personally knew to show what some of the mechanics of the fifties have done.

There were several apprentices and about 800 men in the Windsor shops in the fifties, and after several years' investigation, I find I am the only one left. The others have gone the way of all the world.

I think that, as an average, the mechanics who could be properly called old timers were much more resourceful and were better all around workmen than those of the same class of today. They really had to be to hold their jobs.

You may ask what did I do to show that I am an old timer and in the same class with others I have mentioned. The Detroit Locomotive Works closed its shop in the fall of 1858. After this I worked as a machinist for several roads. Early in 1866, I went to the Aurora, Ill., shops of C. B. & Q. as a machinist. Later I fired an engine for four months and finally ran one for several years. I have held the following positions: roundhouse foreman, master mechanic, general master mechanic and general mechanical inspector. After forty-one years' service with the C. B. & Q. I felt like taking a rest and resigned in 1910. I am past 88 years of age, and all I run now is an automobile.

The Santa Fé Shops at Needles

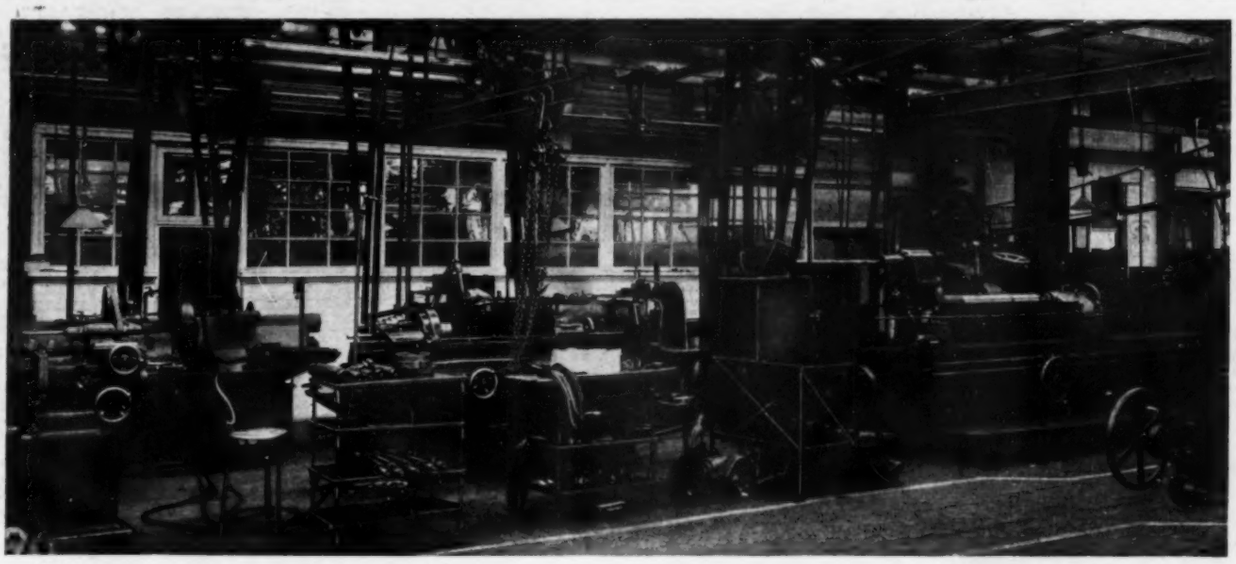
By Clifford H. French

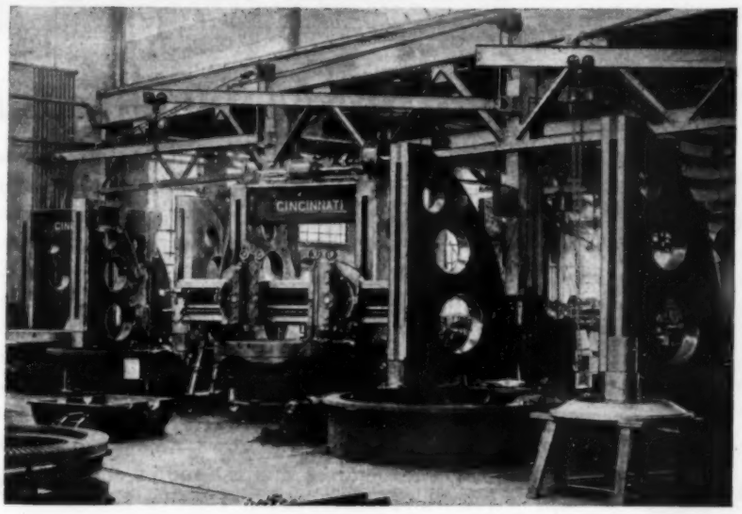
Needles is given the reputation of being the hottest railroad center in the United States. I am told that in summer it is frequently 100 deg. F. in the park at midnight. Without electric fans, sleep is said to be almost out of the question.

The Santa Fé shops at Needles are made attractive by palm trees, cacti and a well laid-out park, which is bordered by walks and in which the grass is carefully watered. The shops are not new, but heavy power is handled here for the mountain division between Arizona and the Pacific Coast. Some of the large locomotive tenders carry 15,000 gal. of water and 5,000 gal. of fuel oil, which is a load of approximately 80 tons of oil and water, not counting the weight of the tender itself.

The large locomotives require a turntable 120 ft. long, one of the few in this country, or elsewhere, of that length. The turntable is equipped with a Boda gasoline motor, such as is used on motor trucks, has an efficient centering rod and locking device to hold it in place when the locomotives are running on or off, and is presided over by a full blooded American Indian who copies his eastern brothers to the extent of wearing a turban.

In addition to using floating bushings in the back ends of the main rods, as at Topeka and other points, here they are trying out floating hub-liners as well. The wheel hubs are recessed as usual and two-part steel liners are put into the recesses before the driving boxes are put over the axles. The liners are about 1-in. thick and the parts are held against movement by two dowels in each side.

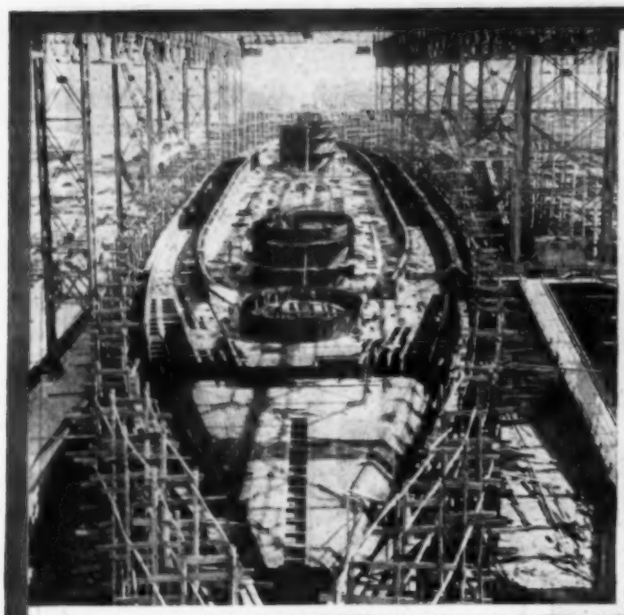


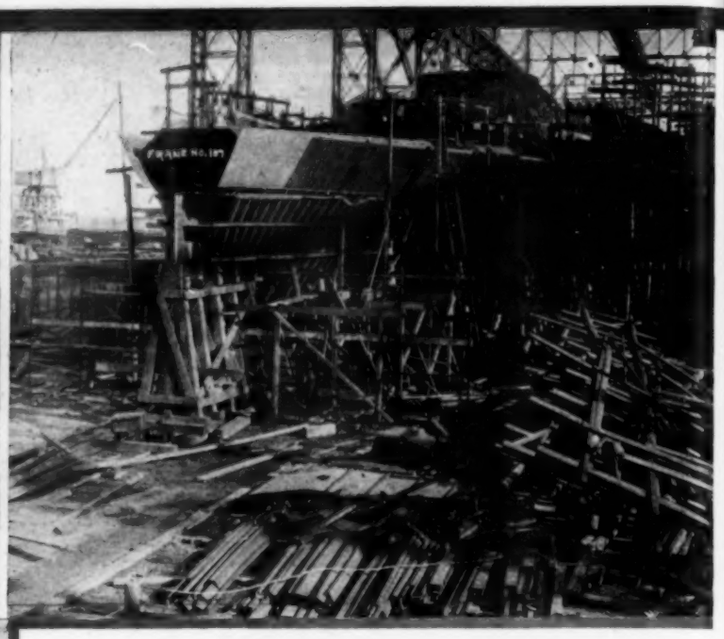


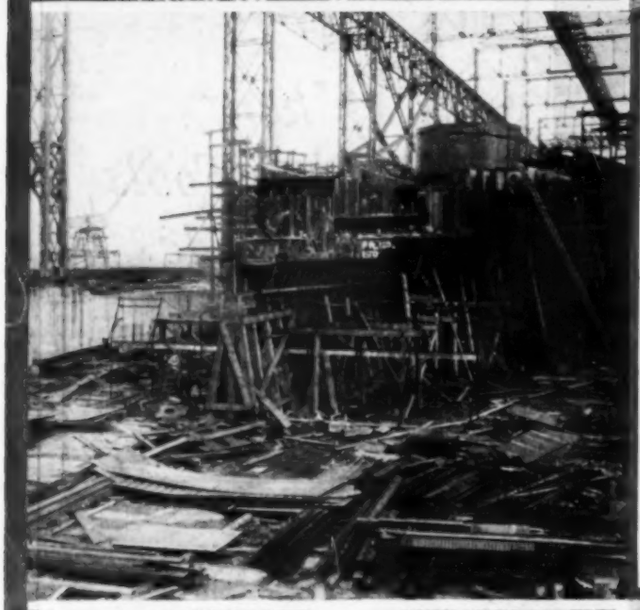
Where Machine Tools Are Made

Cincinnati Planer Company

Organized 1898

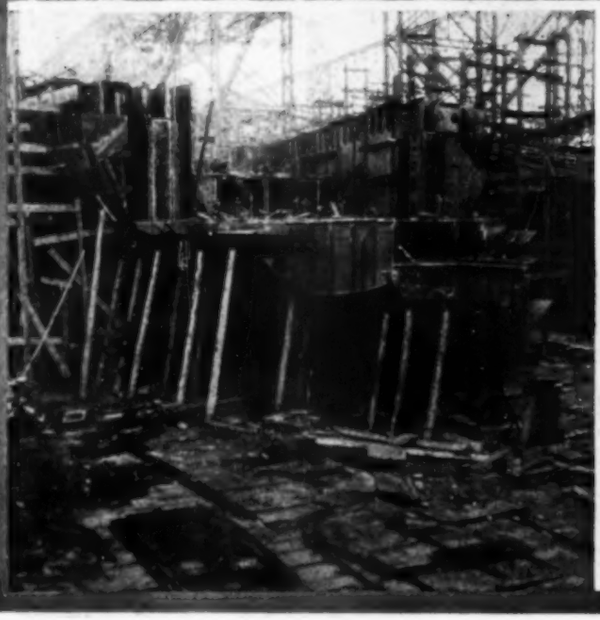


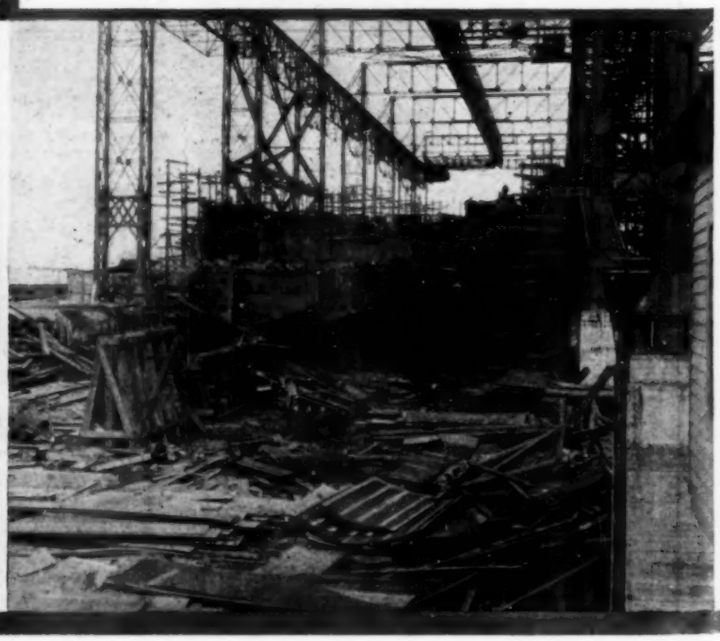


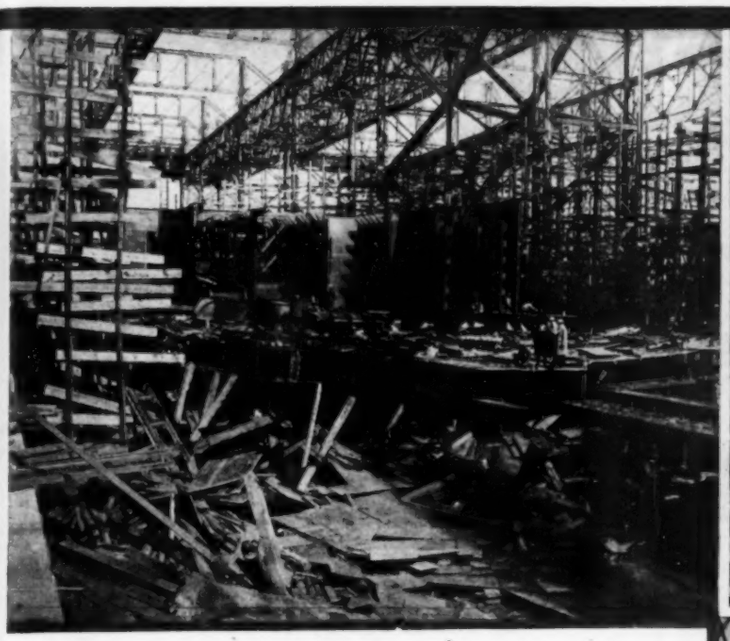


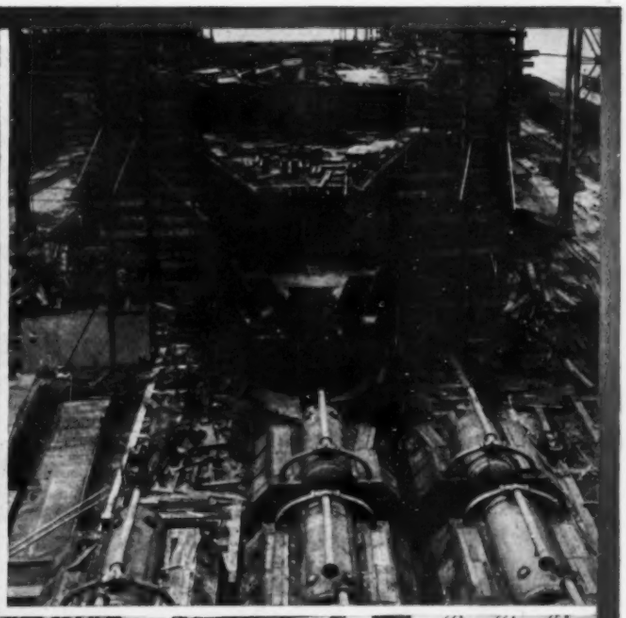
Making Sausages

THE photographs on these two pages and the one following show various stages in the dismantling of one of our unfinished warships, the Iowa. This ship was about 35 per cent completed when work was stopped under the terms of the Disarmament Treaty. It took hundreds of men many months to build as much of the ship as is seen in the upper lefthand corner. A gang of 25 oxy-acetylene cutting torch operators will reduce her 10,000 tons of steel to salvaged plates and charging box scrap, 18x60 in., in a third of the time taken to erect it. The contract for scrapping the Iowa was taken by the Steel Scrap Co., and requires that the shores and stagings be cleared away by Feb. 17, 1925. Cutting is being done with Airco-Davis-Bournonville torches, oxygen and acety-







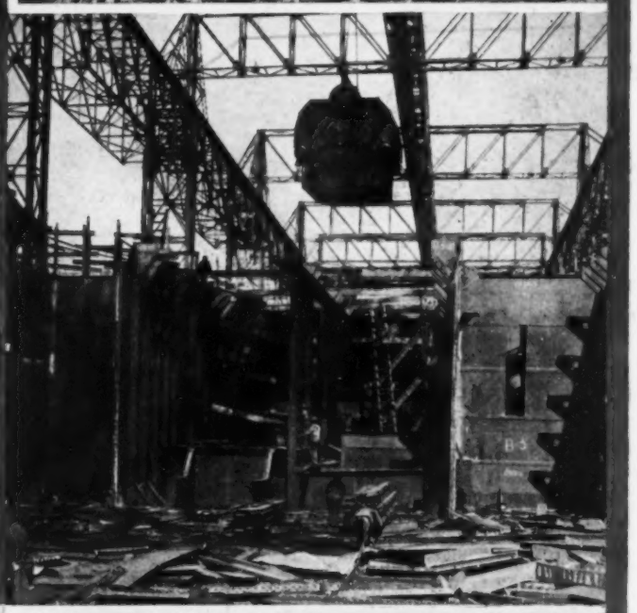


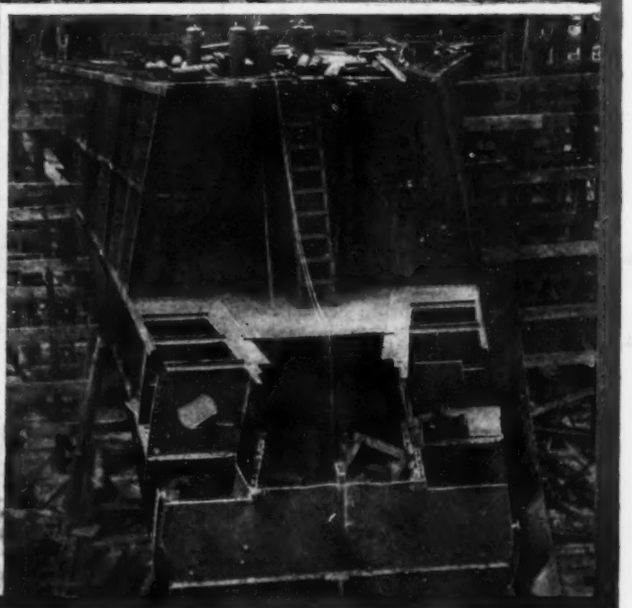
of the Dogs of War

lene being supplied by the Richmond plant of the Air Reduction Sales Company.

The plan of operation pursued by the scrap company is that of cutting down the bulkheads, working from the inside and using the tank top of the double bottom as a deck for cutting the large sections into charging-box and salvage sizes. The bulkheads are cut vertically from the third deck to the tank top leaving ties at the top. When the cross cuts have been made at the bottom the traveling crane chains are then attached and the ties cut, thus eliminating danger of heavy pieces falling and injuring the men. When the bulkheads of a given section have been cleared down and scrapped, the tank top, vertical members and keel plates are cut away. The staging is removed as the work goes forward, leaving the space clear.

Photographs by courtesy of the Air Reduction Sales Company





Making Sausages of the Dogs of War

The photograph reproduced at the left shows some 2,000 tons of charging box scrap waiting to be removed. The views above and below show operators at work cutting up the huge pieces of steel shafting taken from the Iowa. Flanges are cut in half, the smaller sizes of shafting are cut in lengths and the larger sizes into quarters as well. Contrary to common impression, perhaps, the rules of the Naval Limitation Treaty do not require destruction of boilers, machinery, etc., so long as they are not applied to battleship uses. The boilers from the Iowa, twelve in number, of 3,000 hp. normal capacity, and 5,000 hp. under forced draft, are salvaged intact, and may be sold for industrial or commercial marine use. They are visible in two of the illustrations on the preceding page.

Photographs by courtesy of the Air Reduction Sales Company.

A Suggestion System That Works

By K. H. Condit
Editor, *American Machinist*

Eighth of the Gilbreth articles is devoted to suggestion systems — Why they do not work and how they can be made to work—Some useful by-products

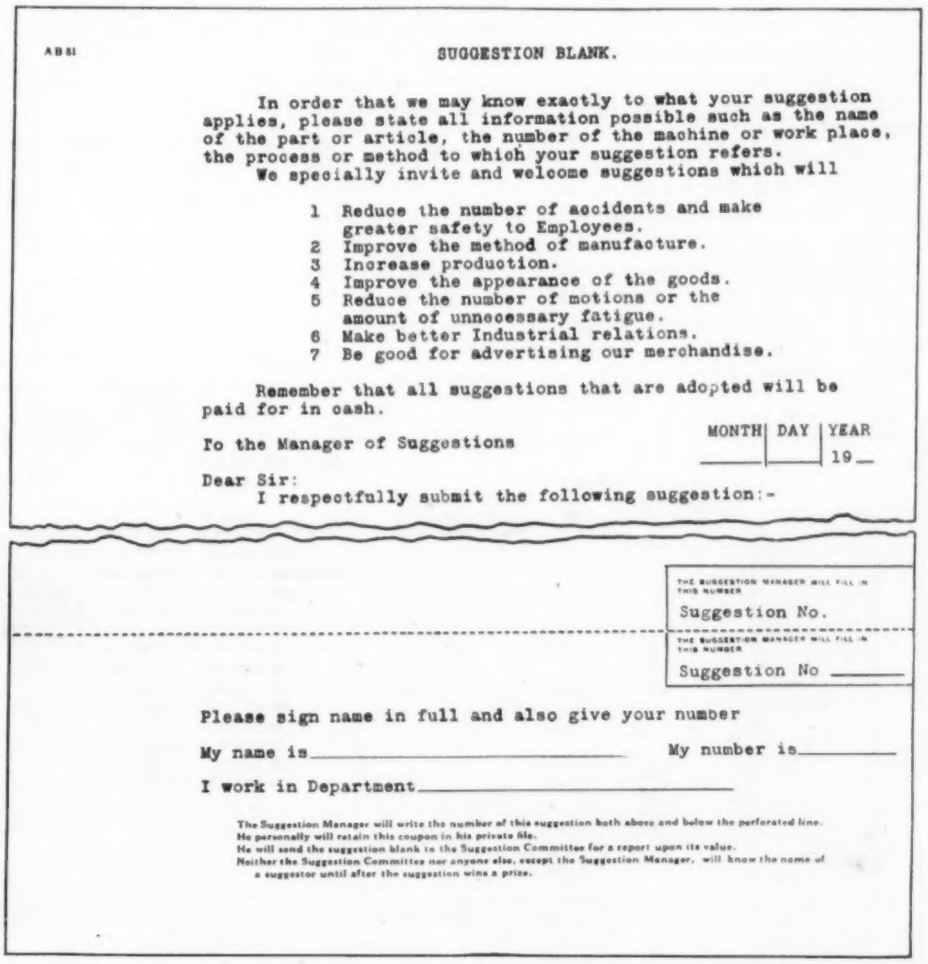
THE SUGGESTION system as it is generally put into effect seldom works for very long. Any one of a number of factors may be responsible for the failure of a suggestion system, but it will probably be sufficient here to mention only the most usual one. The cause of failure I refer to may be described briefly as neglect on the part of the management. As I said in the first of the articles describing the work of Frank B. Gilbreth, Inc., one of the shortcomings of much of the work that is erroneously called scientific management is the attempt to make paper systems do the work of efficient human executives. The inevitable result of such attempt is failure. Most of the ideas so stigmatized are entirely sound in themselves, and when used as tools of management rather than substitutes for it are satisfactory.

The suggestion system used by the Gilbreths is no exception to the general rule. As it exists at present, it is made up of a synthesis of ideas from all of the Gilbreth plants. It has been in existence for more than 20 years and has the distinction of successful operation wherever it has been maintained as first installed.

As its name implies, the purpose of a suggestion system is to secure from the men on the job suggestions for improvement in manufacturing methods. The by-products of a suggestion system, as I shall try to explain later, are often equally important.

Two general types of suggestions will be handed in; those that are patentable and those that are not. In connection with the patentable suggestions, the question at once arises, "Shall the employer steal the idea or help the man get as much out of it as he can?" In the long run, the best results are obtained by helping the man in every possible way. Such help should include advice as to whether or not the patentable idea has any money in it. It is also desirable to supply the services of the company's patent attorney without charge. No general rule can be laid down as to the remuneration due the man for patents obtained on this basis. Local conditions must govern. If the idea is one upon which the inventor can cash in outside of the confines of his own shop, arrangements are usually made by which the employing company gets the use of the patent within its own plant without charge, in return for the assistance given to the inventor.

It is useless to expect the suggestion system to



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SUGGESTION BLANK.

In order that we may know exactly to what your suggestion applies, please state all information possible such as the name of the part or article, the number of the machine or work place, the process or method to which your suggestion refers.
We specially invite and welcome suggestions which will

1 Reduce the number of accidents and make greater safety to Employees.
2 Improve the method of manufacture.
3 Increase production.
4 Improve the appearance of the goods.
5 Reduce the number of motions or the amount of unnecessary fatigue.
6 Make better Industrial relations.
7 Be good for advertising our merchandise.

Remember that all suggestions that are adopted will be paid for in cash.

To the Manager of Suggestions

MONTH | DAY | YEAR
____ | ____ | 19__

Dear Sir:
I respectfully submit the following suggestion:-

THE SUGGESTION MANAGER WILL FILL IN THIS NUMBER
Suggestion No.

THE SUGGESTION MANAGER WILL FILL IN THIS NUMBER
Suggestion No _____

Please sign name in full and also give your number

My name is_____ My number is_____

I work in Department_____

The Suggestion Manager will write the number of this suggestion both above and below the perforated line.
He personally will retain this coupon in his private file.
He will send the suggestion blank to the Suggestion Committee for a report upon its value.
Neither the Suggestion Committee nor anyone else, except the Suggestion Manager, will know the name of a suggestor until after the suggestion wins a prize.

Fig. 31—A good suggestion form

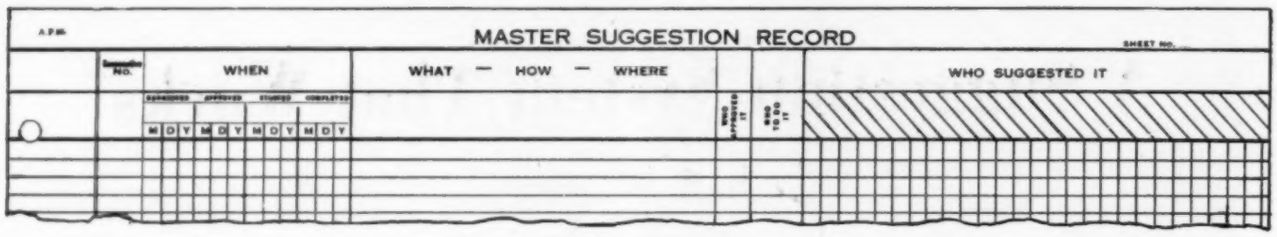


Fig. 32—Master suggestion record

produce worth-while suggestions unless means are taken to stimulate the ideas of the men who are expected to produce suggestions. Information must be fed to the men, usually through the library and the Home Reading Box,* in the hope that they can apply it to their own problems and evolve worth-while suggestions for improvements. The library can supply technical books and technical magazines for circulation inside the plant and for evening reading at home. The librarian should be the type of man who can answer all sorts of technical questions or tell where the answer is to be found and one whose personality encourages the men in the shop to come to him for information and advice. He should also be capable of giving occasional lectures.

No suggestion system will continue to work unless the rate of payment for suggestions is adequate. It is difficult to define what constitutes adequate payment. In some cases payment on a percentage of saving basis is most satisfactory; in others, a flat rate works better. Often it is necessary to do a certain amount of experimenting before the best results can be obtained.

It usually takes some time for a man who has never made a suggestion to screw up his courage to the point of putting one in. When he has finally done so, he wants to know right away whether it is acceptable or not. His feelings in the matter are very much the same as those of men far higher up the business ladder than he is. If a department head, with access to the general manager, has a brilliant idea for increasing the output of his department, he takes it right up with his superior and endeavors to get approval at once. When the big boss himself has such a thought, he does not hesitate either, but sends at once for the man who is to execute it and instructs him to try it out. Undue delay would be very disappointing to the executive, and is equally so to the man at the bottom. Consequently, it is necessary to collect the suggestions from each suggestion box every day without fail.

If the suggestion system is to be taken seriously, and it is a waste of time to fool with it if it is not taken seriously, it is necessary that some one in a high position of authority collect the suggestions from the box. The psychological effect of having the general manager or the works manager do the collecting is worth far more than the few minutes of his time it takes to walk to the box and empty it. Should it happen that he is away from the plant or engaged in important business, his private secretary should make the collection for him. The psychological effect is almost equally good, because it shows that the boss wants the suggestions to come straight to him.

What usually happens is that after a few weeks the manager gets interested in other things and forgets to make his daily collections from the suggestion box. Intervals between collections get longer, the men notice that interest in the suggestion system on the part of the management is declining, and before long it fails to produce any suggestions. The management then decides that a suggestion system is worthless, although the fault is not at all with the system, but with the manager himself for his failure to follow a simple routine.

Everything possible must be done to facilitate the suggestion machinery. The box must be in a convenient place and suggestion forms and envelopes located alongside it. A pencil stub on a string should be attached to the box. As there is a very general tendency for men in the shop to borrow the stub pencils from the suggestion box when they need them, it becomes some-

*See Fatigue Study, Chapter IV, published by Macmillan Co.

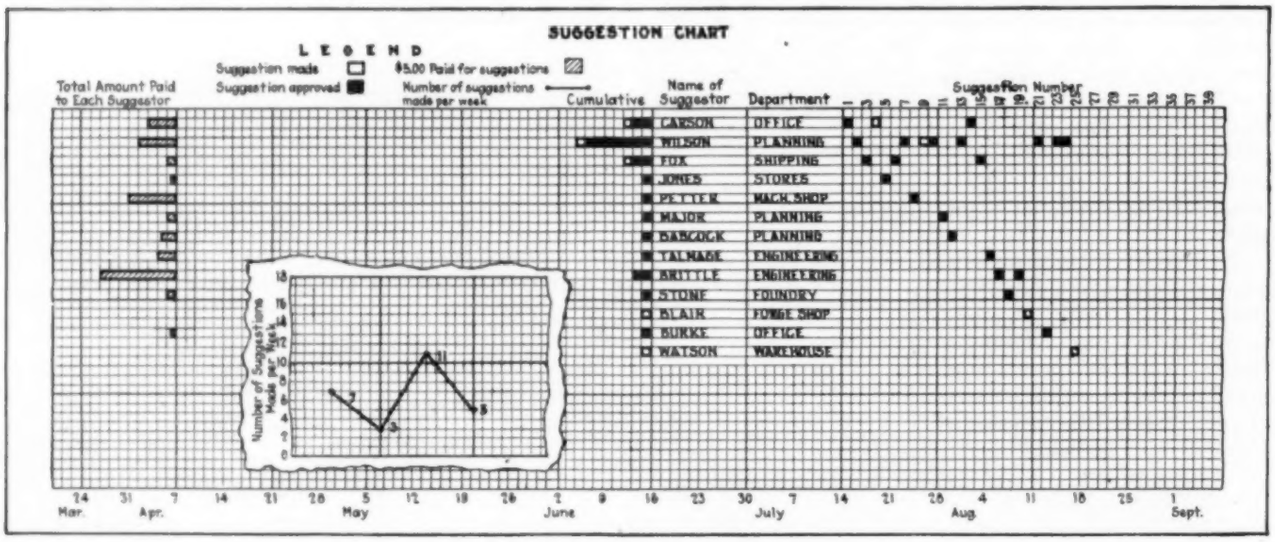
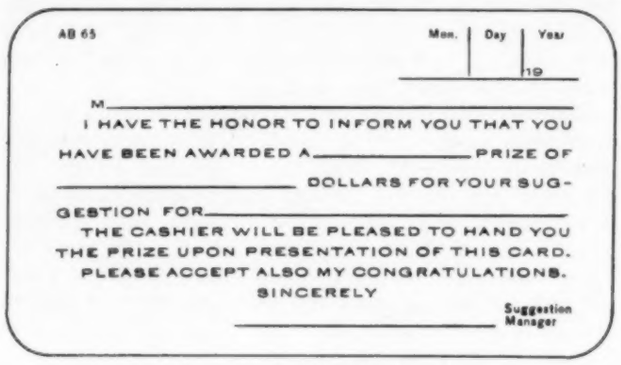


Fig. 33—The suggestion chart

body's job to see that the box always has a pencil on the string. This task is an excellent one to assign to a messenger. Careful attention on his part to this small duty is a good indicator of his fitness for promotion.

Some provision must be made for passing on suggestions without knowing who submitted them. This is necessary to give the man who is unpopular an equal chance. The blank can be made as shown in Fig. 31 with a detachable section upon which the name of the suggestor appears. This section is removed by the individual who keeps the suggestion records.

As a good suggestion often has to be put in two or three times before it is finally accepted, a good filing system is essential. If it turns out that an accepted suggestion has been put in before, the full reward to each suggestor should be paid. The file is also useful


AB 65

Mon. | Day | Year

19

M.

I HAVE THE HONOR TO INFORM YOU THAT YOU HAVE BEEN AWARDED A _____ PRIZE OF _____ DOLLARS FOR YOUR SUGGESTION FOR _____

THE CASHIER WILL BE PLEASED TO HAND YOU THE PRIZE UPON PRESENTATION OF THIS CARD. PLEASE ACCEPT ALSO MY CONGRATULATIONS.

SINCERELY

_____ Suggestion Manager

Fig. 34—Notification card

when a suggestion has to be rejected because of having been received before.

It is well to keep a suggestion ledger or master record, like that of Fig. 32, of all suggestions submitted. In addition to the suggestions received from the men, those that the executives want to try out should be included in the record. The suggestion manager or his secretary will follow up this record and chart the number of suggestions on a per-week basis. Such a chart, Fig. 33, is an excellent barometer of shop conditions and often provides easily readable strike storm warnings.

The suggestion manager or boss must be a high-class man. To aid him in judging the value of suggestions, he should have a chart of names of experts in different phases of plant activity from which he can select committees to consider suggestions of various types.

Payment for suggestions is authorized by sending to the cashier a detachable section of the suggestion blank. At the same time, a good looking card, Fig. 34, is sent to the suggestor, telling him that the suggestion has been accepted and that he can get his money by going to the cashier. Experience shows that men collect these cards and keep them in a pocket to show off. For this purpose the number of cards, rather than the money value represented, has the greater appeal.

A list of the suggestions with the names of the men suggesting them should be posted on the shop bulletin board, both for the psychological effect on the employees and to insure that the suggestions will be carried out.

While the general effect on plant morale of a successful suggestion system is good, there are some disadvantages that must be met. Among them is the suggestion pest, who must be squelched periodically. He corresponds to a certain extent to the despised teacher's pet of our younger days, and it sometimes becomes necessary to get rid of him altogether. There is also the type of man who suggests perpetual motion. His intentions are good, but he lacks education and information. It is often possible for the librarian or the suggestion boss to be of real help to such a man by giving him the right kind of reading matter.

Direct results of suggestion systems can be measured in dollars and cents. One of the Gilbreth plants estimates that annual savings resulting from suggestions received from men in the plant have run as high as $100,000. Indirect results are usually intangible, but in this day, when intelligent management is rapidly on the increase, the value of hearty co-operation between men and management is thoroughly understood. A properly operated suggestion system is a great stimulant to such co-operation.

Sizes of Spheres to Contain Even Quantities

By J. Edwin Sinclair and John M. Ceglowski

Nearly all of the handbooks contain tables giving the capacities of spheres by inches in diameter, but the accompanying table gives the inches in diameter of spheres by their capacity.

As we have never seen a table of this kind, we have submitted it for publication thinking it may be of value to some of the readers of the *American Machinist.*

Table Showing Volumes and Radii of Spheres Having Capacities of ¼ Pint and 1/10 Liter and Multiples Thereof

Pints	Volume in Cubic In.	Radius of Sphere, In.	Liters	Volume in Cubic In.	Radius of Sphere, In.
0.25	7.21875	1.1989	0.1	6.10302	1.1290
0.50	14.43750	1.5105	0.2	12.20604	1.4280
0.75	21.65625	1.7291	0.3	18.30906	1.6350
1.00	28.87500	1.9031	0.4	24.41208	1.7910
1.25	36.09375	2.0501	0.5	30.51510	1.9383
1.50	43.31250	2.1785	0.6	36.61812	2.0600
1.75	50.53125	2.2934	0.7	42.72114	2.1836
2.00	57.75000	2.3978	0.8	48.82416	2.2673
2.25	64.96875	2.4938	0.9	54.92718	2.3581
2.50	72.18750	2.5838	1.0	61.03020	2.4424
2.75	79.10625	2.6664	1.1	67.13322	2.5213
3.00	86.62500	2.7423	1.2	73.23624	2.5954
3.25	93.84375	2.8197	1.3	79.33926	2.6656
3.50	101.06250	2.8895	1.4	85.44228	2.7322
3.75	108.28125	2.9566	1.5	91.54530	2.7936
4.00	115.50000	3.0211	1.6	97.64832	2.8566
4.25	122.71875	3.0827	1.7	103.75134	2.9149
4.50	129.93750	3.1420	1.8	109.85436	2.9716
4.75	137.15625	3.1992	1.9	115.95738	3.0252
5.00	144.37500	3.2543	2.0	122.06040	3.0772
5.25	151.59375	3.3077	2.1	128.16342	3.1275
5.50	158.81250	3.3594	2.2	134.26644	3.1765
5.75	166.03125	3.4095	2.3	140.36946	3.2240
6.00	173.25000	3.4583	2.4	146.47248	3.2700
6.25	180.46875	3.5056	2.5	152.57550	3.3148
6.50	187.68750	3.5518	2.6	158.67852	3.3584
6.75	194.90625	3.5967	2.7	164.78154	3.4010
7.00	202.12500	3.6406	2.8	170.88456	3.4424
7.25	209.34375	3.6834	2.9	176.98758	3.4830
7.50	216.56250	3.7253	3.0	183.09060	3.5226
7.75	223.78125	3.7662	3.1	189.19362	3.5613
8.00	231.00000	3.8063	3.2	195.29664	3.5991
Volume of sphere = $4/3\ \pi\ r^3$			3.3	201.39966	3.6363
π = 3.141592			3.4	207.50268	3.6725
$4/3\pi$ = 4.18879			3.5	213.60570	3.7082
1 Liter = 0.2642 U. S. gal. or 1.0568 quarts			3.6	219.70872	3.7432
			3.7	225.81174	3.7775
			3.8	231.91476	3.8113
			3.9	238.01778	3.8445
			4.0	244.12080	3.8770

Railroads, Their Rates and Efficiency

By Robert S. Binkerd
Vice-Chairman of the Committee on Public Relations of the Eastern Railroads

THE freight service of the American railroads in 1923 was equivalent to hauling over 4,100 tons of freight one mile for every man, woman and child in the country. We Americans, therefore, are about ten times more dependent upon railroad transportation than are the people of civilized Europe. And today we are three times more dependent on railroad transportation than we were only twenty years ago.

So that almost overnight, as large human affairs go —in a single generation or two—we have developed in this country an economic civilization, supremely, uniquely, dependent upon railroad transportation; and this economic society, of which every producer and consumer is a member, is in constant danger of being upset by the unwise agitations of great groups who do not yet understand the laws of economic health.

If we were living under simpler conditions, and all this vast horsepower on which we are so dependent were represented by living horses, everybody would understand that the care and conservation of horses was a matter of life and death concern. A good citizen would be one who was intelligent, careful and considerate with horses. No one would expect to rise to leadership in such a society on a platform of abusing horses, skimping their feed, and poisoning the water which they drink.

Railroad Welfare Essential to Everyone

Yet the fact that this vast horsepower is locked up in the iron and steel of railway facilities should not affect these essential truths one iota. And so we can safely say that a first law of good health of our economic society is that the welfare and reasonable prosperity of railroad transportation is essential to the interests of every producer and consumer.

A second law would immediately flow out of the first; namely, that we cannot have sound national prosperity without railroad prosperity. This springs automatically from the fact that the railroads are the largest corporate consumers of the products of other industry. Between their normal operation, maintenance and expansion, they will take in any year about one-third of the coal output, one-quarter of the lumber output, one-third of the steel output, and one-half of the fuel oil output of the country. Railroad expenditures for fuel, materials and supplies, and new railway facilities, in 1923, were not far from three billion dollars. Between the emloyees who produced these things and their own employees, the railroads must have furnished the living of nineteen million people in 1923. Or, in other words, one family out of every six was dependent on the railroads for its living.

Since 1920 the railroad managements of the United States have reduced the normal cost of producing railroad transportation by over a billion dollars a year. About one-third of this saving comes from reduction in wages. About two-thirds of it comes from an increase in the efficiency and economy of operation. Perhaps the simplest way to illustrate this is to compare the second half of 1922 with the second half of 1920. There was not one per cent difference in the traffic of these two six-months periods. Yet, in 1922, this same amount of transportation was produced by the work of 1,697,000 employees, while, in 1920, it took 2,109,000 employees.

Of this saving of something over a billion dollars a year in the cost of producing transportation, the railroads have already turned back to the consuming public the benefit of about 750 million dollars in reduced freight rates. Most of these reductions were voluntary.

For the freight service which they performed last year, the railroads got an average income of about 1.1 cents for hauling a ton of freight one mile. Ten years ago they got about three-quarters of a cent. So that the increase in the average cost of freight transportation in ten years is only somewhere between 46 and 50 per cent. In passenger transportation the increase is between 55 and 60 per cent.

Some idea of the enormous increase in the costs of producing transportation can be gained from the fact that even now—after all the successful efforts for economy—wages, coal, materials and supplies and practically everything else which enters into railway maintenance and operation, are at least 100 per cent higher than they were nine years ago. Railroad taxes are 160 per cent higher, and now amount to a million dollars a day. Eight per cent of every freight rate in 1924 will go to pay taxes alone.

Instead of being put upon the defensive with regard to rates, I think a proper understanding of the situation entitles the railroads to great credit. They are bearing costs which are double what they were nine years ago, out of rates which have increased only half as much as costs. The railroads are acting as stepdown transformers, translating a 100 per cent increase in the costs of producing transportation into only a 50 per cent increase in the cost of transportation to the public.

Abstract of address delivered before a joint meeting of the National Supply and Machinery Dealers' Association, American Supply and Machinery Manufacturers Association and National Pipe and Supplies Association, at Cleveland, Ohio, May 19, 1924.

How to Prepare a "Chemically Clean" Metal Surface

A chemically clean metal surface is one from which all foreign matter has been *completely* removed. The best way to prepare such an absolutely clean surface is, of course, to file, machine or grind off the scale or other foreign matter and then to remove any oil or grease by washing with alcohol, clean gasoline or hot soda solution. Mechanical cleaning is not always practicable, however, and in such cases chemical methods can sometimes be used. This means immersing the metal for a short time in a solution which will dissolve off the surface of the metal, and then washing off any remaining solution with clear water. Various solutions can be used; the most widely applicable and effective is a dilute mixture of muriatic and nitric acids.

Wherever a chemically clean surface is prescribed, it should be prepared at the time it is needed, for no ordinary metal will remain chemically clean long. Even though a metal may still appear bright after some time has elapsed, it will have acquired in most cases a thin transparent coating of oxide, not to mention contamination by the natural oil of the hands that have touched it.

Fig. 11—Raw material stock yard at Lingotto looking south

The Impressive Story of Fiat

By J. A. Lucas and F. E. Bardrof

Raw material handling at the Lingotto plant — Forging and stamping departments—Drawing and sawing of bar stock—Molding and machining operations in the foundry

BAR STOCK, sheets, tubes, ingots, etc., arrive at the Lingotto plant in the rough state from the steel mills located in other sections of the city of Turin. This material is transported in railway cars or automobile trucks and is unloaded in the outdoor stock yard shown in Fig. 11. This view of the yard was taken looking south from near the south end of the main building, the corner of which appears at the extreme left in the illustration.

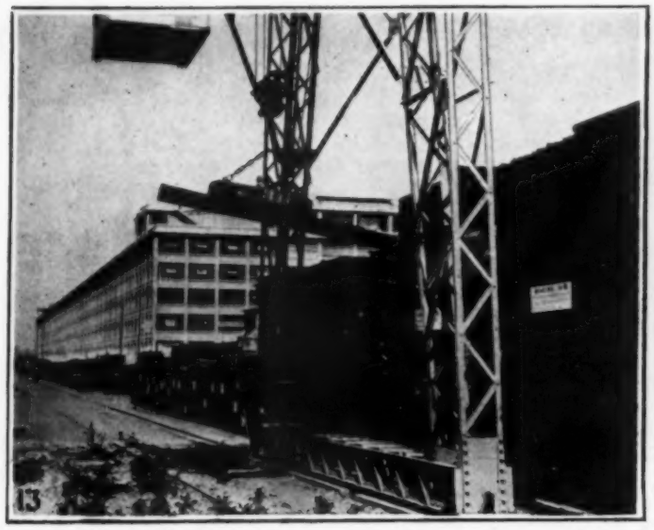
The stock piles appear in the center between the two railroad sidings and are served by the gantry crane. The operating cab of the crane can be seen near the right-hand end, together with the 5-ton lifting magnet by which the material is handled. The single-story building at the right houses the stamping and forging department, the structure at the left and directly south of the main building being employed in drawing and sawing the stock.

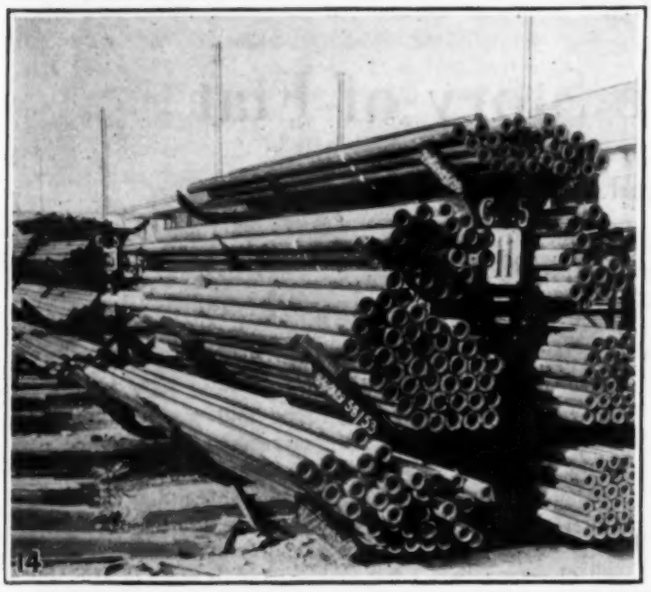
The convenience of this arrangement of yard and buildings is evident, for the crane can be used for unloading cars or trucks, piling material in the yard, and transporting material to either building. Another view of the yards and buildings is given in Fig. 12, the observer this time looking north toward the main building which appears in the background. In this picture the forge shop is at the left and the bar stock handling department at the right.

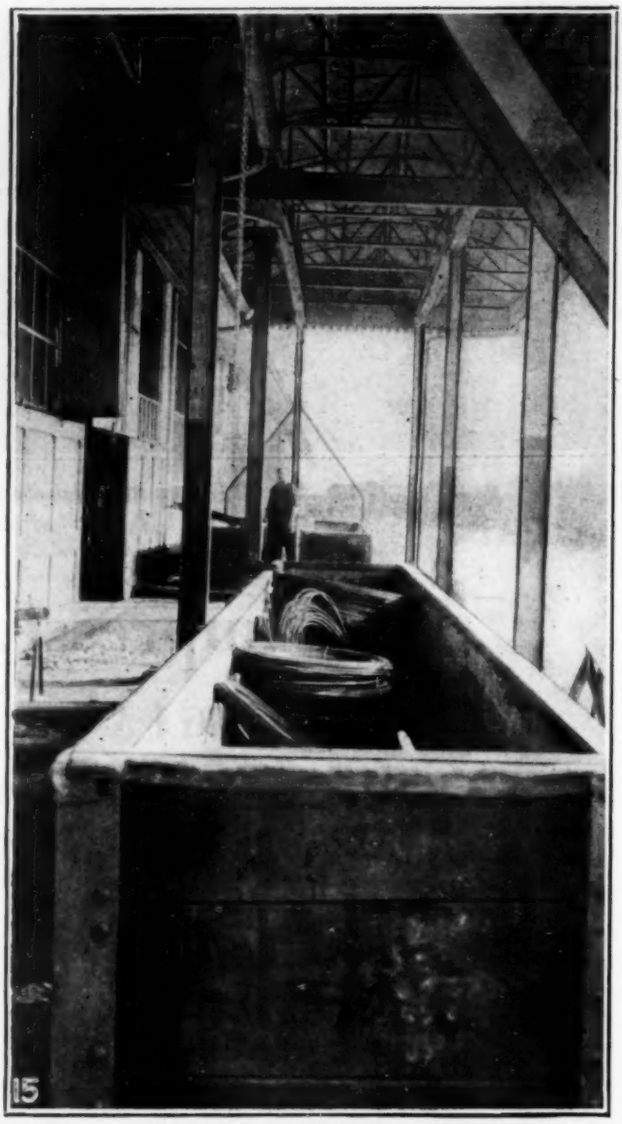
One leg of the gantry crane is shown in Fig. 13. The lifting magnet is handling steel ingots from the large pile between the crane tracks. The care taken in piling and designating this class of material is indicated here, and the method of storing and indexing various sizes of steel tubing is illustrated in Fig. 14. These storage racks are constructed of structural steel and rest on solid concrete founda-

Fig. 12—The Lingotto stock yard looking north

This is the fifth article of the Fiat series. The fourth article was concluded on page 767, Vol. 60, No. 21.







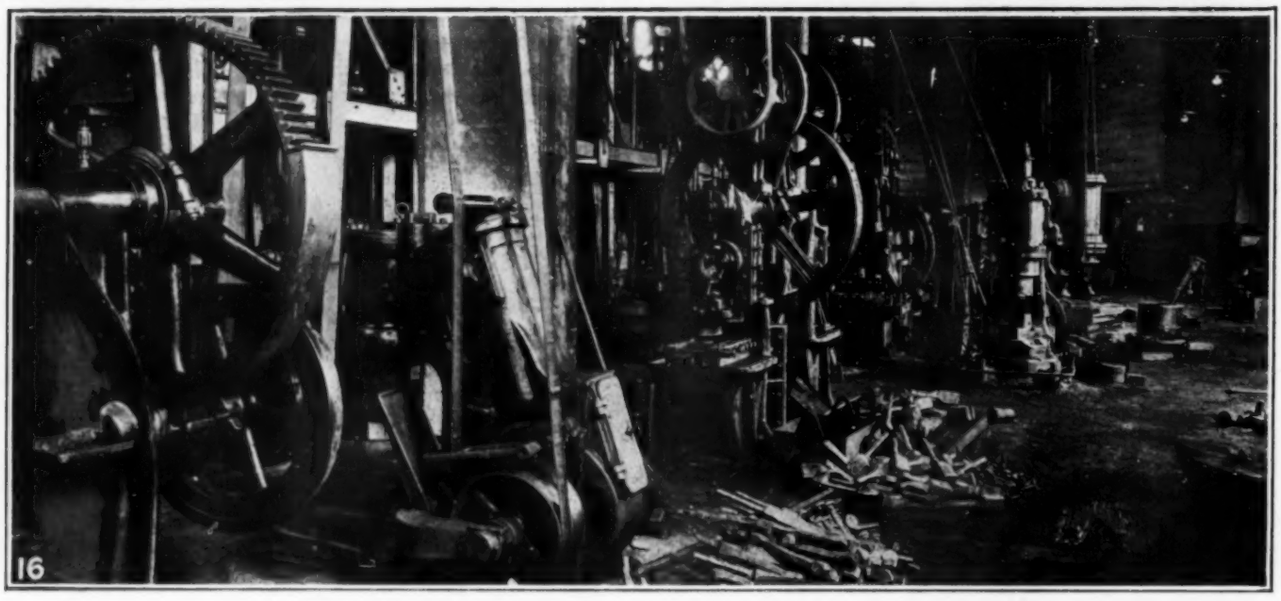


Fig. 13—Piling ingots with the gantry crane. Fig. 14—Stock racks in the yard
Fig. 15—Pickling tanks underforge shop portico. Fig. 16—Part of the forge shop

Fig. 17—Drawing machines for bar stock

tions. They serve to keep the various sizes of material properly segregated, as well as to hold the material in an accessible position and decrease the yard space required.

On the stock-yard side of the forge building, and near the farther end in Fig. 11, is located a portico, beneath which are placed the pickling tanks for cleaning the material. These tanks are shown in Fig. 15, the yard crane and the bulk of the main building being visible in the distance. These tanks are served by a monorail trolley hoist running into the building. It hardly seems that this open-air arrangement would be very well adapted to the rigors of the average North American winter, but it has advantages in the balmier climate of Italy.

Passing into the forge department a quantity of equipment such as that shown in Fig. 16 is seen. Here are a great variety of power hammers and presses, used in making the high-grade steel forgings that give strength and durability to the finished Fiat car. The stamping and forming of sheet metal parts such as fenders, hoods, etc., is also done in this building.

Steel bars and rods are in the roughly rolled state as they come to the Lingotto plant from the mills and must, therefore, be drawn to the proper size for machining before entering the plant. This procedure decreases the amount of stock that must be removed in machining and shapes the stock accurately. We have already noted that this building is across the yard from the forge shop and directly south of the main building of the plant.

As the observer stands at the end of the building at which the stock enters from the yard a group of drawing machines will be seen. These machines are shown in Fig. 17, and one of the trucks by which the material is brought to the machines will be noted in the foreground at the left. The bars are drawn through accurate dies on these machines and the sizes of the bars are carefully checked as they emerge from the machines. For this purpose a complete set of limit gages of both ring and snap types are provided, these gages receiving the same careful attention to insure their accuracy that is given the working and inspection gages in the machine shop.

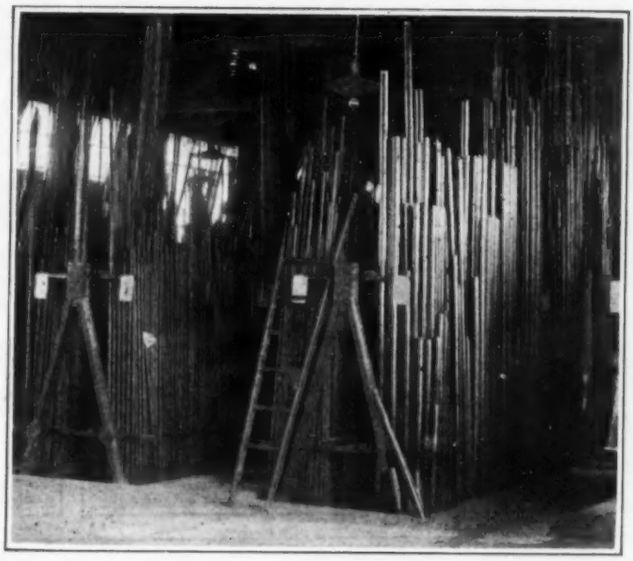


Fig. 18—Racks for drawn stock

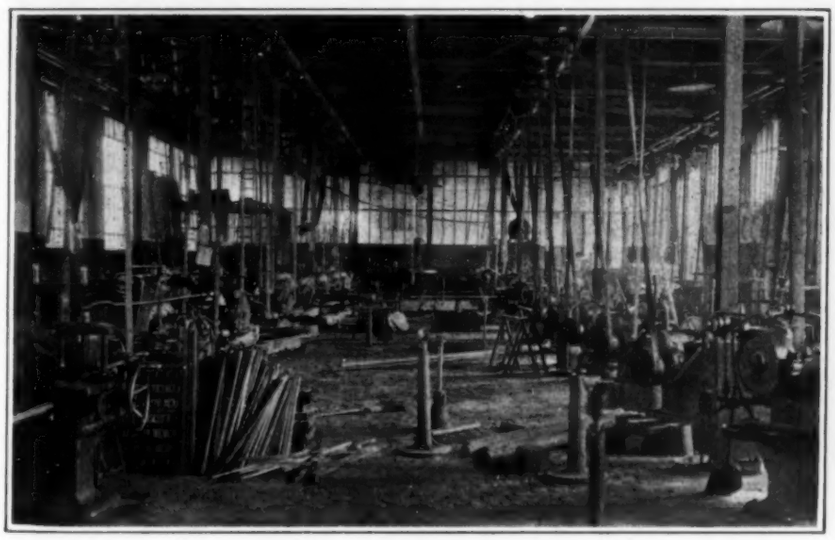


Fig. 19—Sawing machines for bar stock

This preliminary sizing of stock before it is machined is considered very important at the Lingotto plant, on account of the actual time and labor saved by using material that will fit in the collets, chucks, jigs or fixtures designed to hold it during the machining operations. From the drawing machines the stock passes to the racks at the center of the building, shown in Fig. 18. It will be noted that the stock stands upright in these racks to conserve floor space, the lower ends of the bars being placed in pits sunk

Fig. 20—General molding work in the iron foundry. Fig. 21—A group of molding machines. Fig. 22—Molding work on crankcases. Fig. 23—Molds for four-cylinder engine blocks

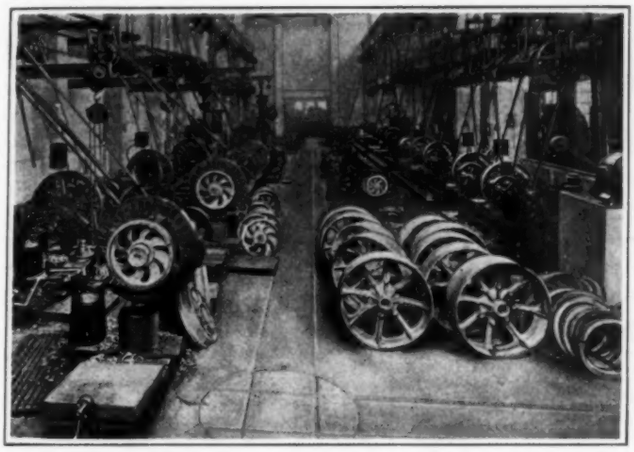


Fig. 24—Heavy tools in foundry machine shop

below the floor level, an advantageous construction.

Beyond the stock racks are located the sawing machines that cut the properly sized stock into suitable machining lengths. This department is pictured in Fig. 19. Many of the machines are of the rotary cold-saw type. From this room the material enters the main building and its further course will be followed in later articles.

In addition to bar stock and forgings, a great deal of the raw material that comes to the Lingotto plant consists of iron, steel and aluminum castings. The Fiat foundries are located in a distant part of the city of Turin and the castings are brought to Lingotto by railway and motor cars. Castings are delivered directly into the main building as they are required for production.

On the opposite page are shown several views of the molding rooms in the various foundries. In Fig. 20 a wide variety of work is being molded by hand, including some fair sized work in the foreground. A group of molding machines is illustrated in Fig. 21, and the modern concrete construction of the foundry buildings is in evidence. Figure 22 shows another group of molders on crankcase work. The molds in Fig. 23 are for four-cylinder engine blocks.

We have noticed that the policy with regard to raw material at Fiat is to have it as nearly ready for accurate machining as possible when it enters the main building of the Lingotto plant. The methods for reducing the bar stock to machining size have been mentioned, and this policy is also extended to castings. At the foundry considerable rough machining is done on the various castings, in addition to the usual cleaning operations. Any great excess of stock is removed from the larger castings to make them ready for accurate finishing.

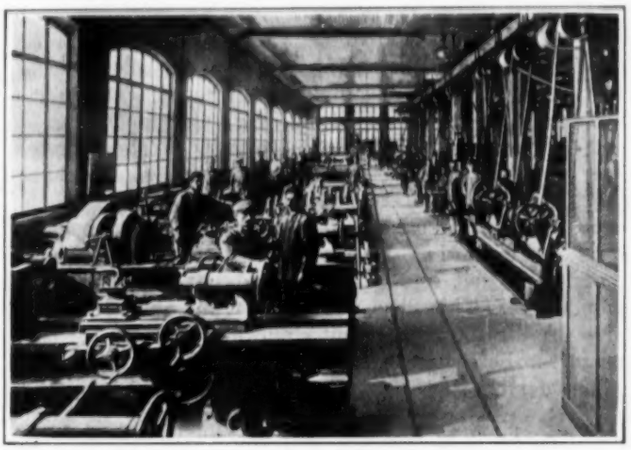


Fig. 25—Another section of foundry machine shop

The machine shops in which this work is done are shown in Figs. 24 and 25, and it is apparent that the tool equipment is heavy and rugged for the severe service required. In addition to the roughing work on automobile castings these shops are also used for production work on such roughly machined parts as truck wheels, car wheels, pulleys, etc., some of which can be seen in the foreground in Fig. 24. A greater variety of equipment is shown in Fig. 25, this section being adapted for general roughing work.

In another article the transportation of raw material, work in process, and finished parts, through the main building at Lingotto will be considered.

Worm Gear Reductions for Heavy Service

By H. Edsil Barr

WORM gearing, although recognized for its ready convenience as a means of speed reduction, has not until quite recently been considered seriously. In the past few years, however, it has been found practical for the general transmission of power under the same conditions commonly imposed on spur gearing. In the past, the commonly accepted opinion of worm gearing has been that it was inefficient and entirely unsuited for the transmission of steady or heavy loads. It has been, therefore, practically limited to either very light service, or to elevators, in which its principle value appeared to be that it would not back up with the load.

General machinery and manufacturing practice owe an immense debt to the automobile, and the higher development of the worm gear began, apparently, with its application to the rear-end drive of motor trucks. In this position it has proved itself capable, when properly designed and constructed, of transmitting power steadily under the most severe conditions. Since this effective demonstration of its possibilities, the worm-gear drive has been developed in large sizes suitable for practically any transmission in which a considerable ratio of speed reduction is required. The successful development promises to be of great value to machinery builders and users, permitting as it does the direct driving of slow-speed machines, line shafts, etc., by relatively high-speed electric motors. The combination of a high-speed motor and a worm-gear unit is a rugged and dependable drive that occupies a minimum of space and is quiet in operation, besides securing the desired speed reduction with the fewest possible parts and bearings.

About three years ago I installed a 60-in. rubber mill in the plant of a client, to be driven by a 100-hp. motor. The space was very restricted. Consideration of spur or herringbone reductions and silent chain drives showed that with none of these could the outfit be placed in the location desired. Further research brought to light the heavy-duty worm-gear unit, but investigation failed to disclose any previous use of this

type of drive upon any work as severe as rubber mill service. It was, however, used at that time with satisfaction in driving rubber calenders—a comparatively easy service.

Careful consideration of the worm-gear unit convinced us that this drive, selected with the full knowledge of the makers as to the service to be imposed and carefully applied, would do the job, and it was decided upon. Except in the case of trucks such worm-drive units had usually been constructed with the worm or high-speed shaft below the driven or slow-speed shaft, the idea being to keep the contact point of the gears under oil. In the application in question, however, this construction was objectionable, because the driven shaft of the mill would be below the floor line and the motor would have to be placed in a pit. It was decided that the teeth of the worm wheel, submerged at its lower rim in the heavy lubricant, would act as a bucket to carry up sufficient lubricant to lubricate and cool the contact surface of the gears.

Worm Unit Mounted On Mill Base

The heavy iron base of the mill was carried out to support the worm-gear unit and to insure permanent alignment. The motor was mounted on planed rails cemented in the foundation, which was integral for the entire outfit. A Francke flexible coupling was installed between the motor and the gear unit, and also between the gear unit and the mill shaft. The motor was of the wound rotor or slip-ring type, adopted for its heavy starting torque with minimum line disturbance, inasmuch as no clutch was interposed between the motor and the gear unit. The synchronous speed of the motor was 900 r.p.m. and approximately 70 r.p.m. was the speed of the driven or mill shaft.

This outfit, shown in Fig. 1, has proved entirely capable of carrying the heaviest loads, within the capac-

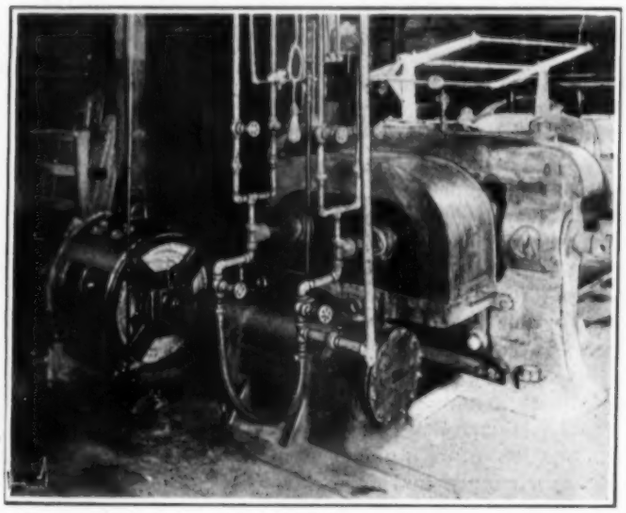


Fig. 1—Worm gear drive for a rubber mill driven by a 100-hp. motor

ity of the motor, steadily and without apparent difficulty or evidence of deterioration, during the past three years of service. The mill is used for warming up cold-mixed rubber stock. The normal full-load amperage of the motor is about 115, but during the early portion of the warming-up period for each batch, the meter swings against the pin at 300 amp. for a fraction of a minute at a time. The load drops at times suddenly to about normal full load and fluctuates between the two points, gradually settling down to about full load as the batch becomes warmed up.

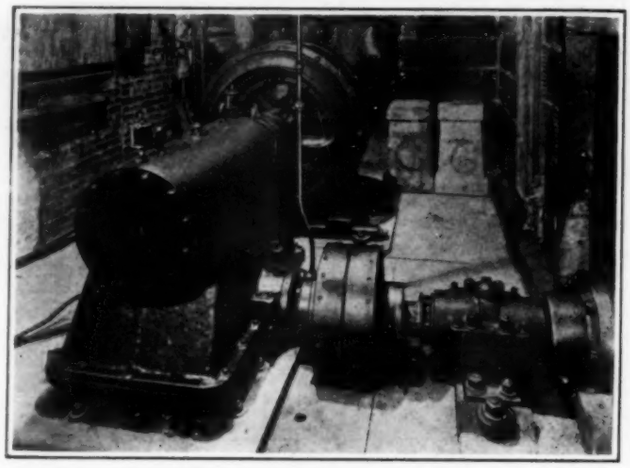


Fig. 2—200-hp. worm unit for rubber mill line shaft

Following the apparently successful adoption of the worm gear in this case, a larger one was installed to drive a 6-in. under-floor mill line, connected to two 44-in. mills, one 60-in. mill and two washers. This worm-gear replaced a spur reduction. The drive, shown in Fig. 2, was connected with a 200-hp. motor running at 600 r.p.m., the driven shaft operating at 66 r.p.m. This drive also handles the full motor load but the fluctuations are not as severe as when only one mill is driven, because the peak loads on the various machines rarely coincide.

In these worm-gear units, the worm shaft is of a special steel, while the wormwheel is of iron with a bronze gear rim. Both driving and driven shafts run in bronze bearings, and a heavy duty ball thrust bearing is provided at each end of the worm so that the drive may operate in either direction. The housing is filled with heavy steam cylinder oil to a given point on a filling gage, and sight-feed oil cups are provided on all bearings. These are used for a few minutes only after starting, in order to insure lubrication until the heavier lubricant starts to circulate. On 150- and 200-hp. units installed later, the lower part of the housing is water-jacketed.

These gear cases have never been opened, except to remove the top plug for examination of the worm teeth, upon which there are as yet no indications of wear. The ball thrust bearings have not been removed for inspection and in fact no attention has been necessary except to insure a supply of lubricant. The lubricant should be renewed entirely every six months.

It has been found advisable to place a sheet metal case over the high-speed Francke couplings, as these must be lubricated and without the case the oil is thrown off. The lower slow-speed coupling generally needs no case, but in locations presenting unusual amounts of grit and dirt it would be good policy to provide one. This case should be made in halves and carry in the lower half sufficient machine oil to submerge the bottom coupling pin.

Considering the severity of rubber mill service and the successful application of the worm gear in these varied cases, it is believed that the worm-gear unit is of practical use for any power requirement when properly designed, applied and installed.

Methods of Machine Tool Design

By A. L. De Leeuw
Consulting Editor, *American Machinist*

Continuation of calculation of differential feed gearing—Effect of varying speed of various parts—Geometrical and arithmetic progression of feeds

BOTH of the systems we have chosen for examples might be useful under certain peculiar conditions but, as a rule, it would be desirable to have a more elastic system than either of these two, so that we will choose a compromise and assume that the shaft makes 2 revolutions for 1 in. feed. In that case we have the following:

for 1 in. feed, A—B = 4; B = 196
for 2 in. feed, A—B = 8; B = 192
for 3 in. feed, A—B = 12; B = 188
for 4 in. feed, A—B = 16; B = 184

The gears required to give these speeds to *B* would have to be in ratio of these speeds, or as 49—48—47—46. Fig. 210 shows the arrangement we would get to produce these results. Both gears *A* and *B* are driven from shaft *C*. *A* is driven by means of a pair of equal spur gears of 50 teeth each. *B* is driven from a set of spur gears on *C* which have the proper number of teeth. The drive is delivered to *B* by means of a cone and tumbler arrangement and the sliding pinion is mounted on the hub of *B*. This is a rather cumbersome arrangement and we notice that our cone and tumbler device differs from similar devices in the fact that there is such a small difference between the gears of the cone.

Remembering that it is possible to use the same blank for spur gears having a small difference in the number of teeth, provided we use involute teeth and make them by the generating process, it would naturally occur to us that it might be possible to make all these gears of the same diameter. This we will do. Instead of making four gears of various diameters, we will make all these gears of the same size and, in order that the actual size shall not differ too much from the theoretical size, we will make our blank correct for 47½ teeth, so that the largest gear will have 1½ teeth more and the smallest 1½ teeth less than we would expect on a blank of this size.

It will now be possible to spread the four gears apart so as to have a space between them slightly more than the face of a gear and instead of using the cone and tumbler arrangement, we simply slide the gear on the sleeve of *B* from one gear to another without the assistance of tumbler or idler. We are not yet out of our troubles, however, for eliminating the idler, we would have gear *B* running in the same direction as *A*, so that we transfer the idler from the *B* to the *A* side, thus causing the gears to run in opposite directions. As the gear on *A* has 50 teeth and the pitch diameter of the four gears corresponds to 47½ teeth, the center distance between the jack-in-the-box and shaft *C* corresponds to 97½ teeth, and we can choose two even gears on *C* and *A* of any size, provided the sum of their teeth is sufficiently less than 97½ to have them clear each other.

It was pointed out that the feed will run in the direction of the faster of the two gears *A* and *B*. Up to now, the gear *A* has been running the faster. If now we add to our system of four gears another series of gears which will run 204, 208, 212, and 216 r.p.m. respectively, we would cause the gear *B* to run as much faster than the gear *A* as it has been running slower than this gear in the previous discussion. Now we will get feeds of 1 in., 2 in., 3 in., and 4 in., just as before, but in the opposite direction. If we should go still a step further and provide one extra gear, which causes gear *B* to run at 200 revolutions, we would cause the gears *A* and *B* to run at the same speed, so that there would be no feed.

We would then have a series of gears all mounted on one shaft and with 46, 47, 48, 49, 50, 51, 52, 53, and

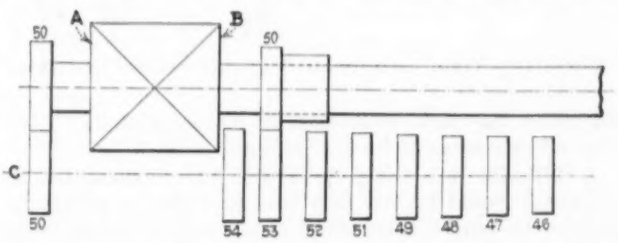


Fig. 210—Compromise arrangement of differential gearing

54 teeth respectively, which would give us feeds of 4, 3, 2, 1, zero, minus 1, minus 2, minus 3, and minus 4 in. Of course, it may not always be possible to use the same size blank for gears which differ as much as those mentioned here. In other words, this artifice has its limits. But it might very well be possible to have two feeds in one direction, two in the other, and a stop—all by the movement of one gear sliding into and out of mesh with a series of gears.

If it were desirable to have the larger number of feeds and also the reverse, and if it were not possible to have all the gear blanks of the same diameter, we would be able to accomplish the same result by remembering that we reverse the feed by making *B* run faster than *A* which, of course, is the same thing as saying that *A* runs slower than *B*. In other words, we will obtain the same results again if we cause *A* to run 200 revolutions for the feed in one direction, and some other number of revolutions for the other direction. As the lowest speed of *B* is 184 revolutions, we must run *A* at

180 in order to make shaft C run 2 revolutions (which is required for 1 in. feed). We will then find the following:

for 1 in. feed, B—A = 4; A = 180; B = 184
for 2 in. feed, B—A = 8; A = 180; B = 188
for 3 in. feed, B—A = 12; A = 180; B = 192
for 4 in. feed, B—A = 16; A = 180; B = 196

As will be seen, the same gears which gave right-hand feeds will now give left-hand feeds, but the gear which gave the highest right-hand feed will cause the minimum left-hand feed. In order to obtain this result, we would have to place two gears on A, of which the numbers of teeth should be in ratio as 200 to 180. We might do this by an ordinary system of sliding gears, except that there must be an idler between A and C. Remembering again how gears may be made of the same blank if the difference of their numbers of teeth is not too great, we will give the two gears on A 40 and 36 teeth respectively, cut them on a blank of the proper size for 38 teeth, have two gears of 36 teeth each on the shaft C (this may be an elongated gear with a face slightly more than three times the face of the other gears), and have an idler slide from one to the other. See Fig. 211.

The above illustrations will show clearly how it is possible to serve a variety of purposes in feed mechanism by the jack-in-the-box or its equivalent. They also indicate some of its limitations.

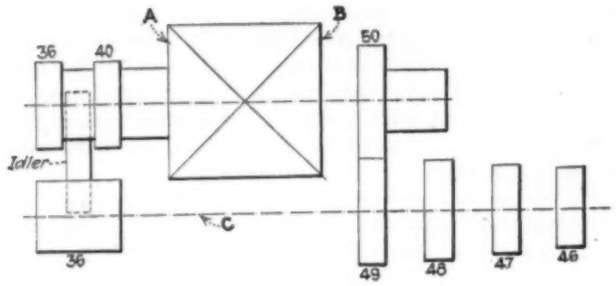


Fig. 211—Final arrangement of differential gearing

A difficulty one would meet with the construction as described would be the fact that in order to make the jack-in-the-box of substantial construction, the distance between its center and the shaft C must be kept fairly large. To string a number of gears on shaft C would bring the bearings rather far apart, and finally, to have a sliding gear on the hub of gear B would be undesirable because its bore would have to be relatively large and, therefore, its hub would have to be long in order to make sliding possible. It would seem to be preferable to have the gears mounted on the hub of B and the sliding gear on C, even when only a few gears are used.

We will now consider what effect such a change will have on the feed. As shaft C runs 200 revolutions and gear B must run 196 revolutions for 1 in. feed, we might place a gear with 49 teeth on C, and with 50 teeth on B. In order to get 2 in. feed, B must run 192 r.p.m., so that we must have a gear on the hub of B with N teeth so that $200 \times 49/N = 192$, and therefore $N = 51\frac{1}{24}$. We find, in a similar manner, that the gears required for 3 and 4 in. feed must have $52\frac{6}{17}$ and $53\frac{6}{13}$ teeth respectively. Of course, we would have to give these gears integer numbers of teeth, so that our series of gears would be 50, 51, 52, and 53 teeth. However, this causes the amount of feed to be slightly different from what we had intended, and this may be allowable in some cases and not permissible in others.

We have seen how a very simple arrangement of a sliding gear and a nest of gears with various numbers of teeth, but all of the same diameter, can be used to obtain various feeds and also how the number of such feeds is limited by the fact that this method can only be employed when the difference in the number of teeth of the nest of gears remains small. This difference may be somewhat greater when the gears themselves have a large number of teeth, or it may have to be kept somewhat smaller when the number of teeth is small. Furthermore, the extent to which we can apply the method also depends to a certain amount on the pitch of the gears. We might go a little further with a heavy pitch. The fact that there is such a limit, however, compels us to look for additional means when we need more feeds than we can obtain with one single nest. Taking the example we had before, namely, getting 1 in., 2 in., 3 in., and 4 in. feed by means of gears with 49, 48, 47, and 46 teeth, and supposing that we are not satisfied with four feeds only but that we wish to have eight, we will investigate to find out what methods can be employed to obtain the additional four feeds.

The simplest method which suggests itself to us is to run the entire system slower or faster. Let us suppose that we want the feeds faster than 4 in., let us say that the next feed shall be 5 in. and that we will obtain this by running the entire system faster. This will mean that we must obtain 5 in. feed when we use the 49-tooth gear, which is the one previously used for 1 in. It will therefore be necessary to run the entire system five times as fast so that gear A will have to run 1,000 r.p.m. We see right away that the speeds become excessive. Moreover, to speed a system up from 200 r.p.m. to 1,000 r.p.m. means that the gear system by which we will do this must have a wide range, 5 to 1, which would mean large gears and corresponding difficulties. We will look for another method by which we can obtain the desired results.

When we use the jack-in-the-box we are not essentially interested in the speeds of gears A and B except, of course, that we want to keep them within practical limits. Our chief interest lies in *the difference* between the speeds of these gears. When this difference was 4—8—12—16 r.p.m., we obtained feeds of 1, 2, 3, and 4 in. per minute. In order to obtain 5, we must have a difference of 20. We cannot do this conveniently by letting gear B run 180 r.p.m. but we can obtain the same result by making gear A run somewhat faster. We will make this difference 20 when we use the 49-tooth gear—that is, when gear B runs 196 revolutions. It will be necessary, therefore, to run gear A 196 + 20 216 revolutions. If we do this we will get the following differences:

216 — 196 = 20
216 — 192 = 24
216 — 188 = 28
216 — 184 = 32

We could go still further and arrange for another series of differences, the smallest being 36. In that case gear A would have to run 232 revolutions and we would then obtain the following series of differences:

232 — 196 = 36
232 — 192 = 40
232 — 188 = 44
232 — 184 = 48

The first column of differences would give us feeds of 5, 6, 7, and 8 in. per minute and the second column would give us further feeds of 9, 10, 11, and 12 in. per minute.

Let us now see what arrangement would be required to make gear *A* run at 200, 216, and 232 revolutions respectively. We have already found that the center distance between the jack-in-the-box and shaft *C* corresponds to 97½ teeth, and further that there is an idler on the *A* side. It was further so arranged that *A* was driven by a pair of equal gears, one located on *A* and the other on shaft *C*. In order to clear each other, these gears cannot have more than 47 teeth, but may have less.

Using an Idler and Long Gear

A very simple arrangement would be to put three gears on *C*, have an elongated gear on the hub of *A*, and an idler sliding along this elongated gear and meshing with the gears on *A* in the order desired. The gears on *C* must be in the proportion of 200, 216, and 232; or as 25, 27, and 29, and must all drive equal gears on *A*. As the low speed of *A* must be 200 r.p.m., and *C* also runs at that speed, the gear on *A* must be equal to the smallest one on *C*—that is, it must have 25 teeth. It is very likely that a 25-tooth gear would be too small to go on the hub of *A*. On the other hand, the next multiples of 25, 27, and 29 would be 50, 54, and 58, and these gears are too large, as we have seen. We will therefore try 1½ times 25, etc., and see what this would lead to.

One and a half times 27 would be 40½ and, as we must have an integer number, we will select 41 teeth for this gear. In order to be in the proper ratio the other two gears would have to be $37\frac{29}{31}$ and $44\frac{1}{17}$ teeth respectively; and, again, in order to obtain integer numbers, we will make these gears 38 and 44 teeth so that the three gears on *C* will be 38, 41 and 44 teeth respectively.

We have introduced here a slight error and we must check up to see whether this affects the desired feeds materially or not, for it must be remembered when using a differential gear system that *a small variation in the speed of a shaft may have a large effect on the final result.*

The elongated gear must have 38 teeth so as to cause the lower speed of gear *A* to be the same as that of shaft *C*, namely 200 r.p.m. The next speed of this gear *A* then, will be $\frac{41}{38} \times 200 = 215\frac{5}{19}$. This would make the first column of differences $19\frac{1}{19}$, $23\frac{1}{19}$ $27,\frac{1}{19}$, $31\frac{1}{19}$, which would make the corresponding feeds $4\frac{1}{19}$, $5\frac{1}{19}$, $6\frac{1}{19}$, $7\frac{1}{19}$, which differs from the desired feeds $\frac{1}{19}$ only, or about 1 per cent. This is perfectly permissible in most cases, and we will find that the next higher series of feeds also is so close to what we intended it to be that we can accept it.

By the simple means now of two sliding gears we obtain a series of feeds ranging from 1 in. to 12 in. There is another feature about this arrangement which makes it unusually handy to operate. In any ordinary gear-shifting system, say with sliding gears, we must take a gear out of mesh with one gear and bring it into mesh with another which runs at a materially higher speed. It is this difference of speed which makes shifting difficult and which may require special devices to facilitate the operation.

When using such a gear arrangement in connection with a jack-in-the-box the sliding gear meshes with a set of gears which have all the same circumferential speed though, of course, the speed on the true pitch diameter is somewhat different. Even at that, this difference of speed is only the amount due to the small difference in the number of teeth, from 49 to 48, or from 48 to 47. This difference is only 2 per cent. As a matter of fact, it is possible to pass the sliding gear back and forth through the teeth of the set of four gears without even noticing whether the gear is passing through an idle space or between the teeth of a mating gear. It is therefore possible to change feed while the machine is running and the feed acting.

With the example taken here, the feeds were in arithmetical progression, or nearly so, and it would not be strange if there were an idea in the head of most designers that nothing but a geometrical progression should be used. It is true that a geometrical progression has certain advantages in certain cases, but it is by no means true that it is the only permissible arrangement.

If we had developed twelve feeds between the limits of 1 and 12 in. and in geometrical progression, we would have found the following amounts for the consecutive feeds: 1, 1.25, 1.57, 1.97, 2.47, 3.09, 3.88, 4.86, 6.09, 7.64, 9.57, 12. It will be noticed that the lower feeds are very close together and the upper feeds very far apart. If the principal use of the machine is with the lower feeds, then the geometrical progression has some advantage because it gives more feeds to choose from.

In Some Cases Arithmetical Progression of Feeds Is Better than Geometrical

On the other hand, the advantage lies with the arithmetical progression if the machine is used more with the higher feeds, because in that case these higher feeds lie closer together. Now, as a rule, production machines are used largely with the higher feeds. If it should be found that the lower feeds are too far apart with an arithmetical progression, then it would be a simple thing to lower the entire range by making the jack-in-the-box run at a somewhat lower speed. Let us say we make the speed of shaft *C* 100 instead of 200 r.p.m. We will then get the following range of feeds: ½, 1, 1½ 2, 2½, 3, 3½, 4, 4½, 5, 5½, 6.

This gives a uniform difference of ½ in. between two consecutive speeds. Looking at the geometrical progression we see that this difference is more than ½ in. except for the first five. If ½ in. difference is about what we desire to have, we would have to divide the geometrical progression by five, and this would make the higher speeds entirely too low for most purposes, and the lower speeds so fine and so close together that they would be entirely useless. If we should divide this series by two as we did with the arithmetical progression, we would still find that the last five feeds have more than ½ in. difference between them. Altogether, it is much easier to obtain a wide range of usable feeds for production work with the arithmetical than with the geometrical progression, and the author is inclined to believe that the geometrical progression is used so largely for feeds mainly because the word has become a kind of fetish.

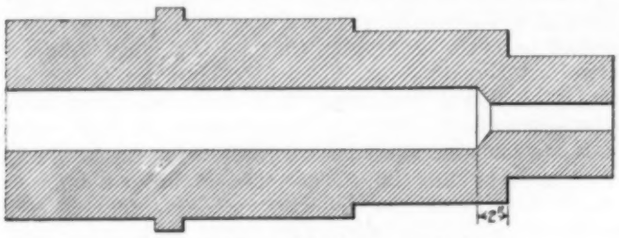
The all-round mechanic has been discussed in various ways for many years. Opinions differ as to his existence or the necessity for him in the modern shop. Many arguments would be eliminated, or at least simplified, if all had the same idea as to what the definition of an all-round mechanic really was. What is yours?

Locomotive Crankpins—Wear and Mounting Pressure

BY CHESTER H. FRANKLIN

The increasing demands on locomotives have necessitated greater care than ever before in the selection and use of materials in such vital parts as crankpins. In practically all cases it is considered necessary to have the main crankpins of modern locomotives made of new material, whether of carbon or of alloy steel.

In some instances, the use of scrapped driving, engine truck, tender, or car axles and old crankpins, is permitted, but in all cases the pins must be forged to the rough size and not merely turned to size. No crankpin, crosshead pin or knuckle pin is to be welded.



Proportions of hollow crankpin

When hollow crankpins are used, the usual practice is to specify two diameters of the hole. The Santa Fé practice is shown in the illustration, where the large hole is drilled to within 2 in. of the shoulder as shown. The large hole in most pins is 2 in. in diameter and the small hole 1 in. On some of the large locomotives the holes are 3 in. and 2 in. respectively.

The life of crankpins on the Santa Fé system is now limited by mileage as well as by the amount of wear. The main crankpins on locomotives of the Atlantic, Pacific, Prairie, Santa Fé, Mikado, and Mallet types are removed after 200,000 miles use, being replaced by new pins. The main crankpins on all other types are allowed 300,000 miles of service, unless previously worn below the diameter limit.

Side rod pins of the Atlantic and 8-wheel types have a 200,000-mile limit and 500,000 miles on other types.

Mounting Pressures of Locomotive Crankpins

Diam. of Wheel Fit, In.	Pressure in Tons—Wheel Centers—Cast Iron	Steel
3	30	36– 45
3½	35	45– 53
4	40	53– 60
4½	45	60– 68
5	50	68– 75
5½	55	75– 83
6	60	83– 90
6½	65	90– 98
7	70	98–105
7½	75	105–113
8	80	113–120
8½	85	120–128
9	90	128–135
9½	95	135–143
10	100	143–150
Crank Axles		
All crank disks		110–150 tons
All center webs		150–200 tons

The wear limit on main crankpins is ¼ in., and on side-rod crankpins ⅛ in. Crank-axle pins and journals are allowed ½ in. wear.

The mounting pressure for crankpins and crank axles is given in the accompanying table. The pressure required must be more than the minimum for the first third of the length of the fit and the actual final pressure, close to the maximum.

Motor Shop Problems

Special vs. Standard Machines

BY FRANK C. HUDSON

EVERY motor-shop man who is responsible for results has long studied the problem of strictly special machines vs. standard machines with special fixtures and tooling. The solution usually depends on the volume of the production, but we occasionally find enthusiasts for one or the other type of machine, almost regardless of the size of the shop.

With a thoroughly standardized product, of which we have but one really shining example, there is no question as to the use of highly developed specialized machinery. Here the output is so large that "standby" equipment comes as a matter of course, even in the most highly specialized machines. And the lack of standby equipment is one of the serious drawbacks of machinery in shops where a large part of the output is tied up in a single machine.

Only last week the production manager of a well known shop was regretting that he had ordered a strictly special drilling machine for certain work instead of a standard machine with special drilling heads. The demand for more production had tempted him to order the special machine, and then the production schedule had been cut in half with very little warning. We sometimes seem to forget that what we want is economical production for the average output rather than for either the minimum or maximum. And economical production must be figured to include machine overhead as well as direct labor, as the latter is frequently the smaller of the two items.

There seems to be, however, a tendency away from the strictly single purpose machine in most shops, both as to semi-automatic and hand-operated machines. Standard milling machines for example, are being equipped with special fixtures and tools to handle certain jobs. The milling machine acts as an adjustable base for the fixture and also supplies power for the cutting tools. Frequently one or more extra cutter spindles are driven from the main spindle and several cuts, either straight or angular, are taken at the same time. When for any reason, the style of the part to be machined changes, new fixtures and cutters are made, and the milling machine still serves as before.

In a similar manner heavy-duty vertical-spindle machines are used for drilling, boring, facing and milling. Special tool heads together with special fixtures are easily bolted to the spindles and tables and frequently a cam or other feed is arranged so that the machine becomes semi-automatic and two or more spindles can be handled by one man. As with the milling machines, these machines form bases for tools and fixtures that will handle a large variety of work and that can readily be changed from one job to another. Except for the shop building a product with few changes from year to year, simple machines that can be made highly productive with special fixtures and tools, seem to have the best of the argument.

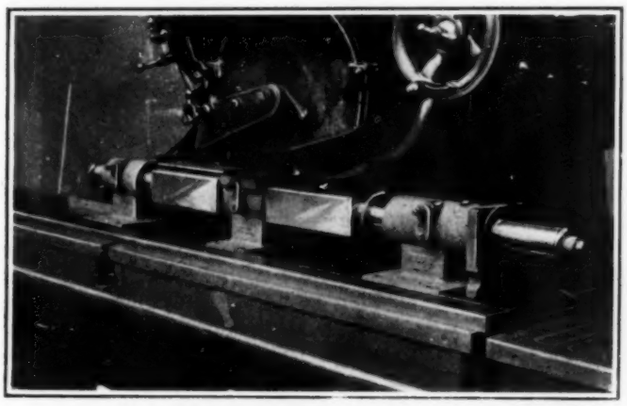
Ideas from Practical Men

Devoted to the exchange of information on useful methods. Its scope includes all divisions of the machine building industry, from drafting room to shipping platform. The articles are made up from letters submitted from all over the world. Descriptions of methods or devices that have proved their value are carefully considered, and those published are paid for

Grinding the Tool Slides of Gridley Automatics

BY JACK WILLIAMS

The tool slides of the Gridley automatics must be accurately square and parallel, if they are to pass the rigid assembly tests that are given these machines before they are allowed to leave the shops of the builder, and in order to make them so they are finished by grinding on a Brown & Sharpe surface grinding machine. The holding fixture here shown is the outcome of several experiments in which various forms of indexing mechanisms were tried out in the effort to accomplish the work in production quantities; all of them being abandoned in favor of this simple rig.



Grinding the Gridley tool slides

The hole through the slide is not parallel, but is tapered slightly at each end; therefore the piece could not be supported on a parallel arbor without some sort of expanding bushing, and the introduction of such bushings would be very likely to bring about errors of parallelism if not of squareness.

The fixture consists of three separate brackets, bored in exact alignment, all resting upon the surface of the magnetic chuck—or, rather three chucks, which are part of the regular equipment of the grinding machine—and three arbors that in the illustration appear to be one long arbor. These arbors pass through the brackets and enter the tapered holes in the slides, the inner end of each long arbor and both ends of the short central arbor being tapered accordingly.

The arbors are hollow and a single long binding bolt passes through all of them, forcing the tapered ends to a bearing in the slides and binding the whole string together as one unit. The parallel portions of the arbors are ground to a wringing fit in the brackets and the latter are each provided with means of clamping the work sufficiently tight to prevent the possibility of its moving while under the wheel. The work is set before starting the first cut, as well as at each indexing, by means of a try-square used in connection with "draw-strips" of tissue paper.

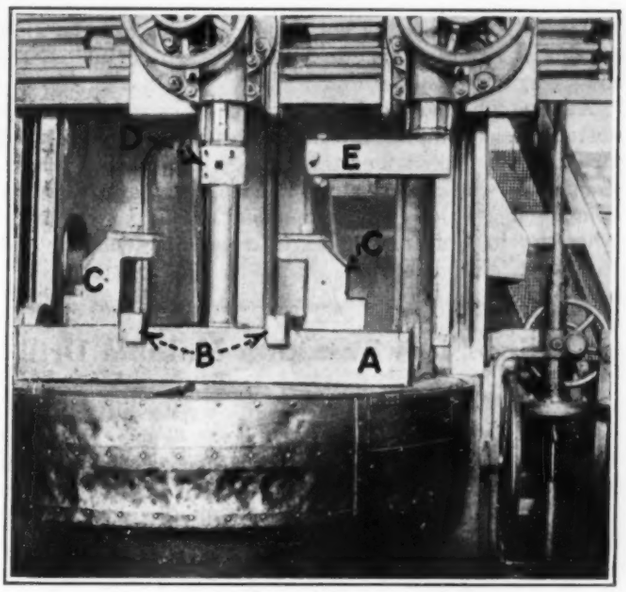
The pieces are tested after grinding by "squaring around"; a process that would show a multiplied error at the fourth position of the square if any error at all existed, but in order to render the work acceptable to the inspector the square must hold the papers equally well in all four positions.

Boring Fixture for Driving Boxes

BY CHESTER H. FRANKLIN

At the Kingsland shop of the Lackawanna Railroad is a very efficient fixture for boring and facing driving boxes. The base *A* carries two parallel strips *B*, on which the driving box rests while it is held by screws in the uprights, or jaws *C*.

The boring bar *D*, is provided with a substantial pilot which bears in a bushing in the base *A*, and prevents the bar from springing away from the cut. The box is faced at the same setting, by a tool in the offset holder *E*.



Boring fixture for driving boxes

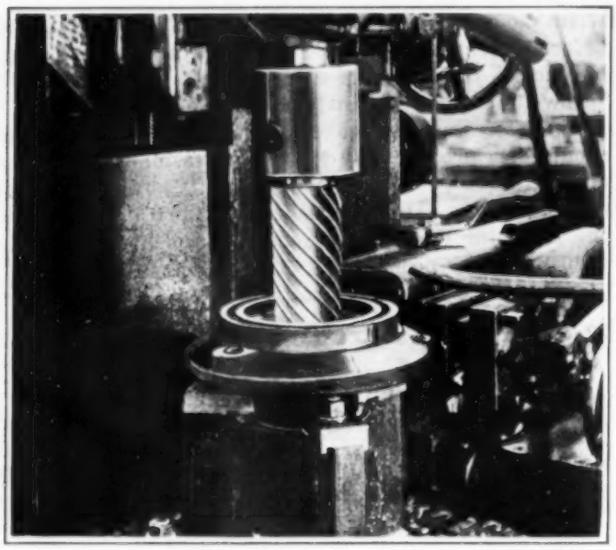
It will be noted that the table is surrounded by a guard of sheet metal, which prevents the operator from getting against the revolving table and also keeps the chips from being thrown around the floor by centrifugal force. The chips strike the guard and drop beside the machine, through openings between the guard and the base.

Helical-Fluted Taper Reamer for Brass

By Milton Wright

The reamer shown in the accompanying illustration is used by the Bullard Machine Tool Co. to ream a bronze bushing in a certain part of its product.

The reamer is 3 in. in diameter, has 12 left-hand helical flutes with a helix angle of about 40 deg., and is tapered 0.003 in. in the length of the bushing; which is about 8 in. It is held by a floating holder that allows it



Helical-fluted taper reamer

to align itself with the bored hole and imposes no side strains. From 0.005 to 0.010 in. of metal is removed by it.

Anyone who has used taper reamers, especially in the softer metals, knows the difficulties to be encountered through the tendency of the reamer to bind in the hole, gouge the work, and finally to break off before having completed its job. This reamer shows no tendency whatever to bind, and it leaves a perfectly smooth and highly polished surface.

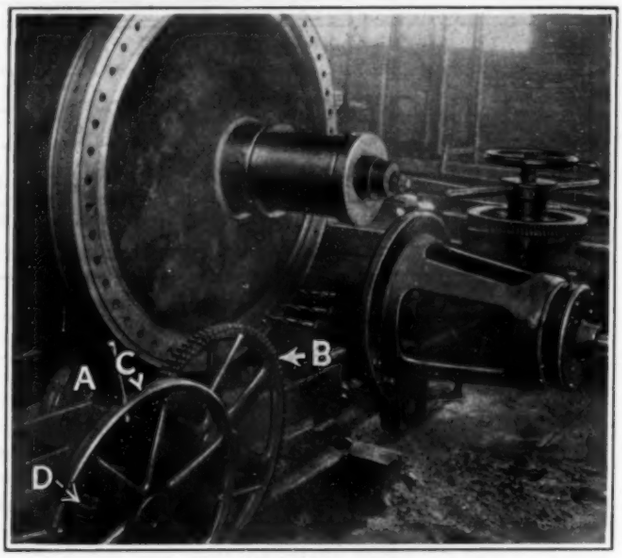
Drilling Sidewise with a Multiple Drill

By Clifford H. French

In fitting the heads on some large drums, the holes for the studs were drilled through heads as shown herewith. As the drums are about 48 in. in diameter and 12 ft. long, it was not easy to drill them on end, so the multiple drilling machine was laid over on its side, the frame being carefully leveled and secured in position by blocking and tie rods.

The drum was mounted on four rollers one of which may be seen at *A*. One of the roller shafts carries the gear *B* on its outer end. The pilot wheel *C* has a pinion *D* on its shaft, meshing with the gear *B*, and thus giving considerable reduction between the pilot wheel and the rollers that carry the drum.

Three holes were drilled at one setting, then the drum was revolved the proper distance by the roller arrangement, and the next set of three holes drilled. The drills could be fed into the work by the regular power feed, or by hand, as desired.



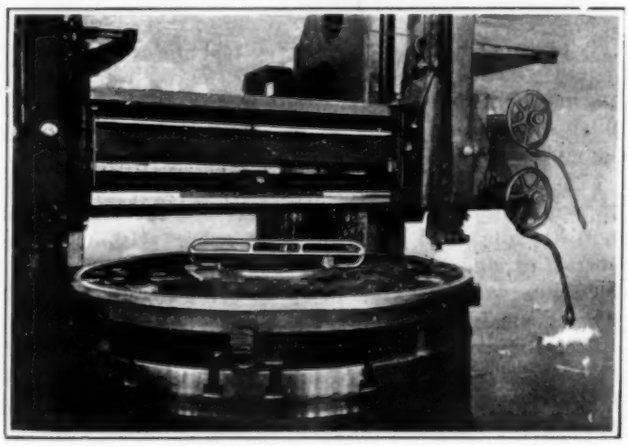
Drilling and indexing laundry drums

Originally the drums were turned on the rollers by means of a rope wrapped around them, but turning them in that way was slow and laborious. The present device has saved much time and labor for the Asher Mfg. Co., Irvington, New Jersey.

Tubular-Frame Snap Gages

By Amos Ferber

In the shops of the Bullard Machine Tool Co., Bridgeport, Conn., where much of the work is of large proportions, yet must be made with the same degree of precision as the smaller parts, the problem of snap gages is solved by making them of steel tubing, firmly braced and with joints carefully brazed together. The



Tubular-frame snap gage

gaging points are shouldered plugs of hardened steel, driven into the open ends of the tubing.

This makes a gage that is very light in proportion to its strength and rigidity, and one that is easily restored to size when the gaging points have become worn. The gage shown in the illustration is a comparatively small one. Others of practically the same construction are made up to 72 in., to cover the outside diameters of parts similar to the one shown on the table of the mill.

Making Spindles for Machine Tools

By S. W. Brown

The making of spindles for lathes, milling machines, etc., presents no great difficulty to the manufacturer of whose product they are a regular part. It is only in the job shop, or the shop where other kinds of work are conducted, that the making of a spindle is attended with annoyance and delay. In the majority of cases the mechanic who tackles the job does not possess the necessary training and experience in that kind of work. Though it is an apparently simple job I have seen many mechanics, skillful enough on other work, fall down upon it.

Most machine spindles have a tapered hole at one end to receive an arbor, a cutter or a center, as the case may be, and it is essential that this hole be true and concentric with the outside, else the tools will "run out." The proper method of inspecting the taper hole of a spindle

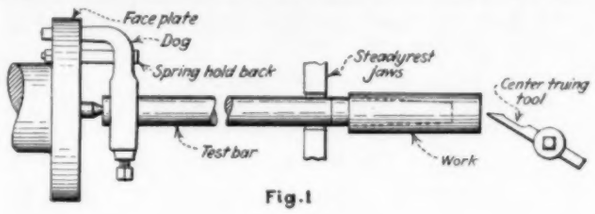


Fig.1

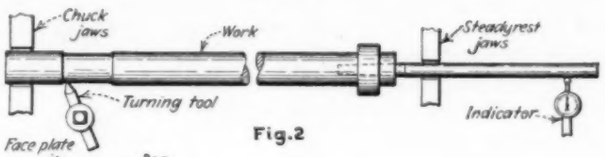


Fig.2

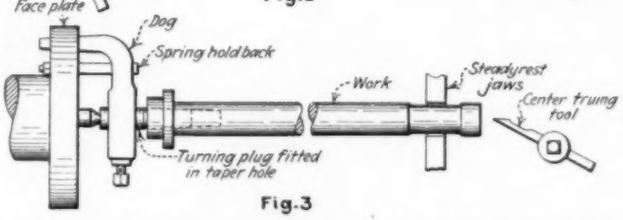


Fig.3

Fig. 1—Scraping the center of the short spindle; work running on test-bar. Fig. 2—Turning bearing spot on long spindle; work running in chuck and steadyrest. Fig. 3—Truing the outer center; work running on turning plug and in steadyrest

for concentricity and truth is to fit into it a taper-shanked bar, usually called a test-bar, with a parallel portion about 18 in. in length and any convenient diameter, and to test the truth of this bar while the spindle is rotating by applying an indicator in three positions—near the mouth of the taper hole, midway of its length, and at the extreme end of the bar.

A taper hole may be concentric with the spindle at the outer end and still run badly at the inner end, or it may be concentric at the inner end and out of true at the outer end. Again it is possible for it to be concentric midway of the length of the taper and eccentric at both inner and outer ends. The problem is to make a spindle that will be concentric with the taper hole over its entire length.

The method of making a spindle most commonly adopted by the average man is to finish it to grinding size on centers, and then steadyrest it and drill, bore and ream the taper hole. A centered plug is then fitted to the hole and the spindle ground to size on centers. As an alternative he may make the tapered hole first and do all of the roughing and finishing with the work running upon its original center at one end and upon the outer center of the plug at the other. In either case there is not one chance in a hundred of getting a true hole, and the worst of it is that error in this respect cannot be remedied without making the tapered hole too large.

It is not a good idea to harden or caseharden spindles all over. Indeed it is often well enough to select a rather hard and tough grade of steel and not give it any heat treatment whatever. If the spindle is to be hardened, the threads should be roughed out and covered with a protecting coating while the bearings only are treated. If threads are finished and the spindle then hardened, the threads are likely to be distorted.

Having decided upon the nature of the after treatment that the spindle is or is not to get, the bar is centered, placed in the lathe and roughed out, leaving a finish of not more than $\frac{1}{16}$ in. Next, swing up the job in the steadyrest and bore and ream the taper hole.

Having finished the taper hole to size there are two courses to pursue, depending upon whether the spindle is long and heavy or short and light. If the latter is the case the test-bar itself is swung up in the steadyrest with the taper end toward the tailstock, and the taper hole placed over it. Running thus unsupported except by the test-bar, the center in the outer end of the spindle is trued up by means of a center-scraping tool.

If the spindle is long and heavy, it should be mounted in the lathe with the rear or small end held in a four-jawed independent chuck and the other end in the steadyrest. Before swinging it up, the lathe carriage and the steadyrest should be transposed so that the turning tool will be available for work close to the chuck jaws.

Next push the shank of the test-bar into the tapered hole in the spindle and true it up by adjusting the jaws of the chuck one way or another as shown by an indicator applied to the test-bar, until it runs true. The end of the spindle next to the chuck will now be found to run out slightly, and a space sufficiently wide for the steadyrest jaws must be turned, as close to the chuck jaws as possible.

The work can now be taken out, the positions of carriage and steadyrest again transposed, the live center and the driveplate substituted for the chuck and the spindle again mounted with the turning plug on the live center and the newly turned surface running in the jaws of the steadyrest. In this position the rear center can be "picked up" with the center-scraping tool.

The illustrations Figs. 1, 2 and 3 show the foregoing operations respectively. Fig. 1 is the short spindle (or, it may be, a collet) mounted upon the test-bar, and the outer center being trued by the scraping tool. In Fig. 2 the long spindle is held in the chuck and steadyrest while the bearing spot is being turned close to the chuck jaws, after having trued up the test-bar by altering the position of the rear end of the spindle in the chuck jaws. In Fig. 3 the spindle is again mounted in the steadyrest and is running upon the turning plug at one end and upon the newly turned bearing spot at the other, while the rear center is being scraped.

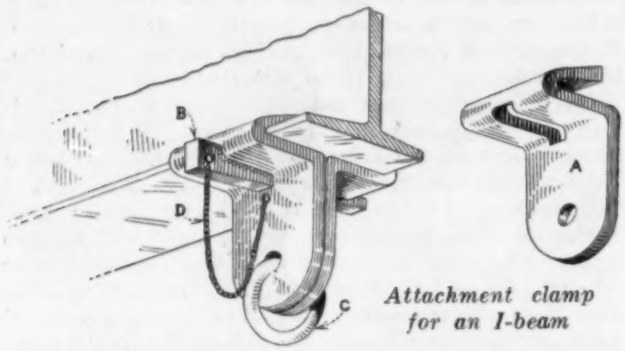
After the rear center has been trued up the steadyrest may be removed and the spindle finished upon centers by turning; or it may be hardened, straightened if necessary, and finished by grinding. If reasonable care is taken in all these operations the taper hole will be found to be true and concentric.

Attachment Clamp for an I–Beam

By John Stewart

A clamp that can be quickly attached to or detached from the lower flange of an I-beam for suspending a hoist, is shown in the accompanying illustration.

The clamp is made of two pieces of machine steel, one piece of which is shown at *A*. Both parts are slotted to receive the key *B*, and drilled for the ring *C*. The ring is welded after being passed through both



Attachment clamp for an I-beam

parts, the holes being large enough to allow free motion of the parts for attaching and detaching the clamp.

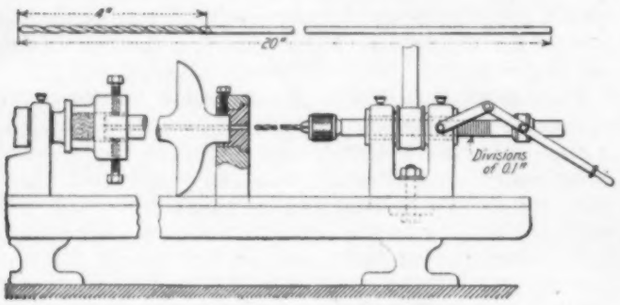
In order that all parts may be kept together, the key is fastened to one of the parts of the clamp by the chain *D*. A hammer blow at either end of the key will lock or release the clamp instantly.

Drilling Deep Holes in Hard Material

By A. Silvester

The sketch herewith shows the set-up adopted in our shop for a job of deep-hole drilling in which it was important that the hole be straight and in line with the axis of the work. The piece is a part of the breech mechanism of a gun, and is of chrome-nickel steel of 55-ton tensile strength and exceptionally hard. The length of the piece is 18 in. and the drill of 0.140-in. diameter.

Our first idea was to swing the piece with the outer end supported in the regular steadyrest and drill the



A rig for drilling deep holes

hole with a stationary drill, held by a chuck in the tailspindle of the lathe, but we found that this would not do at all. We tried all kinds of drills available, ground in every conceivable way, but the hole would wander from the center and often the drill would break before it reached the opposite end of the work. In that case it was cheaper to scrap the piece than to remove the broken drill. We found by test, that if the hole showed a departure of 0.002 in. from concentricity in the first inch of drilling it would be "out" at least 0.1 in. by the time we had reached a depth of six inches.

After several discouraging attempts to do the work in this way we made the device here shown to carry a rotating drill-spindle, which was driven by belt from a pulley on the countershaft. A special steadyrest was made, in which the end of the piece was supported by a bushing of hardened steel having a hole of a size to accommodate the work, part way through, while the remainder of the hole was of a size to guide the drill.

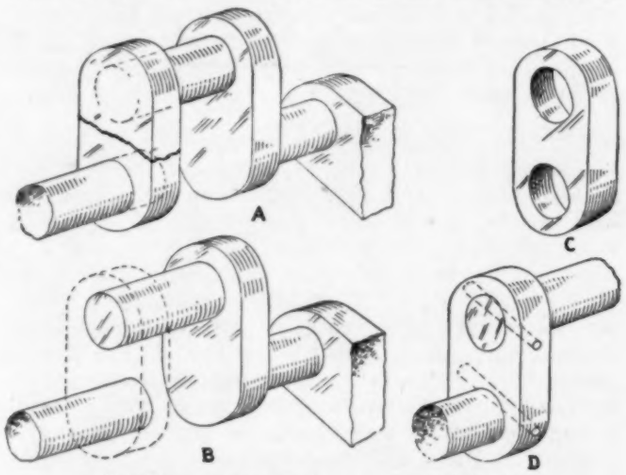
The drill spindle was comparatively short, and therefore correspondingly stiff. After drilling into the piece for a short way, the binding bolt of the drill-head would be released and the head drawn back to free the hole from chips. The 0.1-in. divisions on the drill-spindle assisted the operator in keeping his movements uniform, and by using plenty of lard oil and turpentine to lubricate the drill, we were able to complete the drilling at the rate of one piece per hour.

Repairing a Crankshaft

By Francis C. Henry

The Reeves Machine Co., Atlanta, Ga., like most job shops, prides itself on being able to tackle any job that comes along. A recent example is the repairing of a double-throw crankshaft for an obsolete machine. After trying for a week to locate a new crankshaft that could be used, the owner of the machine insisted that the old one be repaired.

The break was across one web, as shown at *A*. Welding was not considered desirable so another plan



Putting a new web on a crankshaft

was devised. The broken portions of the web were turned off as shown at *B*, lengthening the crankpin and shaft by the thickness of the web. Then a piece *C*, was made of high-grade steel, the two holes being bored at correct center distances and of the proper diameter to give a good, press fit on both shaft and pin.

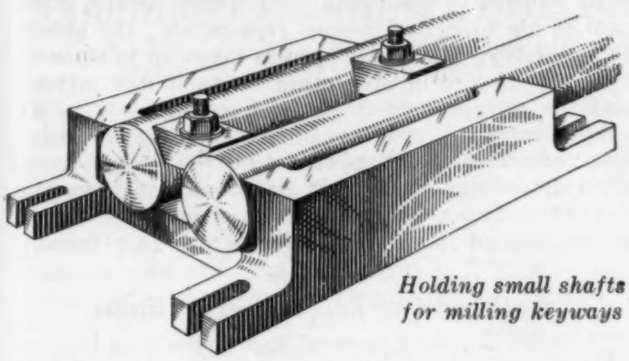
The holes were countersunk to allow room for brazing metal and the new web carefully brazed at both ends of each hole. Then to still further insure its staying in position, taper steel pins were driven through the web and shaft as shown at *D*. Of course the job cost more than the new shaft did in the first lace, but less than the cost of forging and machining one to order.

Fixture to Hold Small Shafts for Milling

By William F. Sandmann

The fixture shown in the accompanying sketch provides a handy means of holding shafts that require a keyway to be milled along their entire length.

The sides of the fixture against which the shafts bear are beveled to an angle of about 30 deg. and the ends of the short clamping pieces are beveled to the same angle. Short stud bolts, permanently screwed into the base of



Holding small shafts for milling keyways

the fixture, serve as a means of fastening the clamping pieces, and to remove or reload the work the nuts are run back only far enough to allow the clamps to be swung parallel with the shafts, when the latter may be lifted out of the fixture.

This device holds the shafts quite firmly and presents no obstructions to the passage of the cutter and arbor over their whole length.

A Set of Tools for Bending Tubes—Discussion

By L. R. Heston

The writer was very much interested in the set of bulldozer dies described by Cyril B. Clark in an article under the title given above, on page 518, Vol. 60, of the

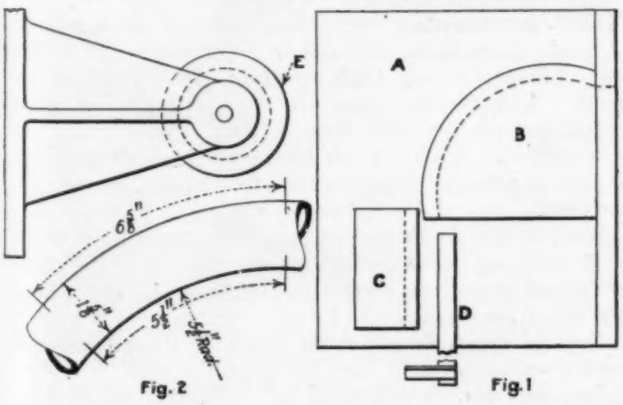


Fig. 1—A set of simple bending tools for tubing. Fig. 2—Experiment showing the action of the material in bending

American Machinist, but cannot see the need of such a complicated set of tools. The illustration, Fig. 1, shows a die that has been used successfully for bending thousands of pieces of brazed steel tubing of 1½-in. outside diameter and with ⅛-in. wall.

A standard die-plate *A* has attached to it the blocks *B* and *C* in the positions shown. The block *B* has a groove turned in it that is ⅛-in. deeper than one-half the diameter of the tube. It is important that this groove should be made a tight fit for the tube, so that when the latter is forced into it by the action of the machine it cannot expand sidewise and will consequently be prevented from flattening. The block *C* should also be grooved to a good fit for the tube, and the gage *D* may be added, if desired, for duplication or production work.

The ram carries the roller *E*, which is also grooved to fit the tube and is so set as to barely clear the block as it advances. The tube is pushed by the roller *E* around the block *B* without being distorted. No arbor or filling in the tube is necessary. The tube is bent cold and without lubricant of any kind.

By changing the blocks *B* and *C* and the roller *E*, various sizes of tubes may be bent to any reasonable radius. Different angles may be obtained by setting the stationary die accordingly, and any part of a circle may be produced by moving the tube around the die for the sucessive strokes of the machine. Reverse bends may be made at will. No clamping device is needed, as the wedging of the tube in the tightly fitting groove in block *B* prevents it from slipping around.

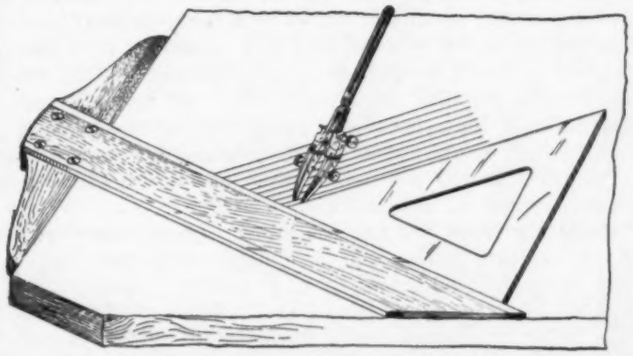
In bending brazed tubing it makes little difference whether the seam is on the inside or outside of the bend, but it must not be at the side as it will then be opened by the stretching of one half and the compressing of the other half of the tube.

We recently conducted an experiment to determine the action of the material while bending. A piece of tube of 1⅝-in. outside diameter and ⅛-in. wall was bent in the above described tools. Before bending it we located two points 6 in. apart on opposite sides of the tube. After the tube was bent to a radius of 5½ in. and to an angle of 45 deg. the distance between the respective marks, measured with a flexible scale, appeared as in Fig. 2; 6⅝ in. on the outer, and 5½ in. on the inner radius.

A Substitute for the Section Liner

By John J. Thompson

As a substitute for the expensive section liner, take a railroad pen and set the two pens the distance apart that you wish to make your section lines. Fill only one pen with ink, and use the empty pen as a marker to



Railroad pen used as a section liner

follow the last line drawn. In this manner a nice job can be done, and all the lines spaced equal distances apart.

The sketch illustrates how the pen is to be used.

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Lack of Balance in Automobile Shop Equipment

A PROMINENT automobile production man in discussing a paper at the recent A.S.M.E. meeting raised the question of proper balance in the machine equipment of automobile plants. Of course, no blanket statement that will cover all plants can be made. Some few are beautifully balanced, others are badly balanced and the rest fall somewhere between the extremes.

Administrative policy has much to do with equipment balance as was clearly evident in the survey of automobile plants on which the *American Machinist* articles, "What About Automobile Shops," were based. Some companies have a policy of spreading an equipment appropriation over the whole plant, replacing one or two old machines in this department and two or three in that one. Others put all their eggs in one basket by taking one department at a time and spending the whole appropriation to make that department the last word in productive efficiency.

Another aspect of the lack-of-balance situation presents itself when reduced schedules are called for. If the balance is poor, economical production of a smaller number of units than that for which the shop was laid out becomes very difficult. A noteworthy example of careful planning for reduced production is the Franklin transmission assembly layout described some months ago in the *American Machinist*. In this case the plan had been carefully thought out and works very well.

Balancing the equipment of a shop so that it will produce economically in dull times as well as in busy ones is no easy job but it is one that must be done by every builder of machinery sooner or later.

What Will the Next Congress Do?

CERTAIN political wiseacres foresee the election of Calvin Coolidge and a Democratic Congress next fall and some of them predict dire results or, rather, the lack of any results at all. The *American Machinist* does not aspire to be a political journal but it does aim to be of as much assistance as possible to the business men of the machine industries. For their comfort it may be said that there is a large section of the community that would not miss the helpful efforts of such a Congress as the late unlamented one if an administrative-legislative deadlock should occur.

Certainly there are far too many ill-considered laws on the statute books and any happening that would tend to prevent additions to their number could not be considered as an unmitigated evil. Some good legislation failed of passage but a far greater amount of bad legislation—the Barkley-Howell Railroad Labor Bill for example—also was lost in the final shuffle. Just so long as legislators of the La Follette type are returned to Congress will the doings of that body be regarded with suspicion by the constructive forces of the country.

Co-operation on the B. & O. R.R.

IT IS interesting to note that the co-operative plan between the management and the shopcrafts of the Baltimore & Ohio has now been extended to every important repair point and seems to be working out satisfactorily to both sides. Meetings are held at the various shops and a general meeting with delegates from each shop was recently held in Baltimore.

In addition to discussing such specific details as the care of air tools, tool rooms, repairs, etc., the general topics of labor and material were taken up to show the necessity of care in preventing waste of new material and for salvaging used material so far as it is economical to do so. Meetings of this kind, when held in a spirit of real co-operation, cannot fail to do much toward securing greater economy of operation and promoting the harmonious relations so essential to real success in as complicated an organization as a modern railroad.

Political Campaigns and Business

THERE is a very general impression that business is always adversely affected by Presidential campaigns. See any trade report written within the last six months. The chances are ten to one that one of the hindrances to prosperity mentioned will be that 1924 is a Presidential year. According to a recent bulletin of the Alexander Hamilton Institute the impression is not borne out by the facts. Over a period of a hundred years there is no evidence that political campaigns have had much effect on the business cycle and its orderly development. There have been such exceptions as the Bryan free silver scare of 1896 but they have been few. Nothing of the sort is in prospect this year for the principles and programs of the two big parties differ so little that business is not greatly affected, no matter which one is in power in Washington.

Just Suppose

JUST suppose that *every* shop trained its quota of boys. Gave them training in all departments of the shop. Made the pay high enough to be a real inducement. And taught them the fundamentals of good citizenship at the same time.

If they did, where would be the cries about shortage of skilled men, no more all-round mechanics, radicals in the ranks?

Some shops do these things. They train boys to be proficient and valuable mechanics and men, and they are broad enough to keep on doing it when other shops get these men away.

Now if *every* shop did its share of the educational work—well,

Just suppose.

It is both significant and hopeful that builders of machines which directly cut the cost of production are running their shops on nearly full schedule in most cases.

The significance is that managers are alive to the need of better equipment and it is a hopeful sign when they will order machines for the business which they feel sure is just around the corner.

Shop Equipment News

Cincinnati Bickford 21-In. Direct-Drive Drilling Machine

The accompanying illustrations show a manufacturing drilling machine recently brought out by the Cincinnati Bickford Tool Co., Cincinnati, Ohio. It is another step in the direction of furnishing simple machines with few and simple adjustments for the shop which manufactures in quantity and where the wide range of feeds, speeds and adjustments is merely a cause of high cost of the equipment and a handicap rather than an advantage in its operation.

This machine is self contained with its driving motor so that it can

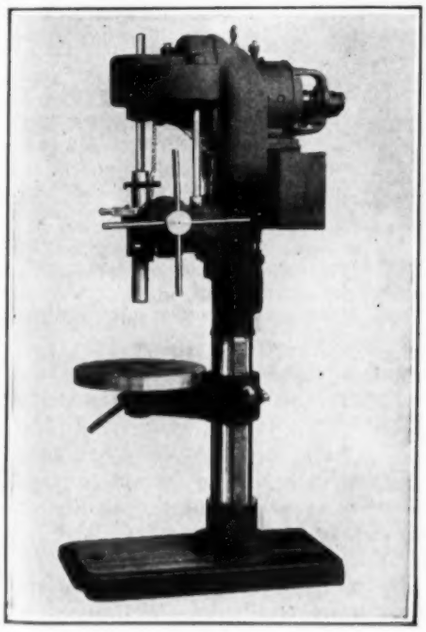


Fig. 1—Cincinnati Bickford 21-In. Direct-Drive Drilling Machine

be placed or grouped to the best advantage. It is provided with only one speed and one feed, but both feed and speed may be selected; the possible speeds ranging from 48 to 707 r.p.m., while a feed may be had between the limits of 0.006 to 0.030 in. per revolution.

A vertical adjustment of the motor makes it possible to change driving gears if a different speed is desired, for instance when the machine is assigned to another job. To facilitate the placing of the machine in a different location or position, an eye

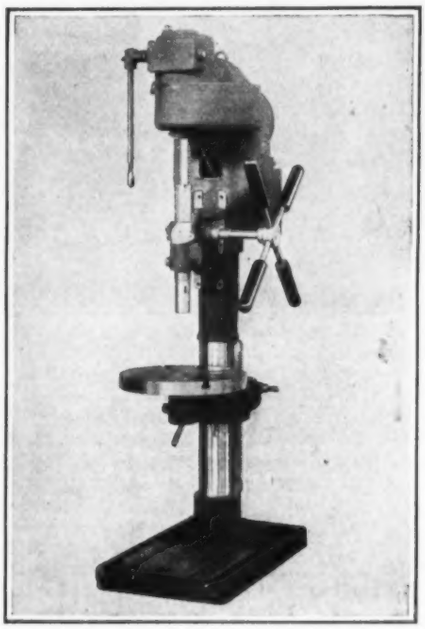


Fig. 2—Cincinnati Bickford machine with geared tapping attachment

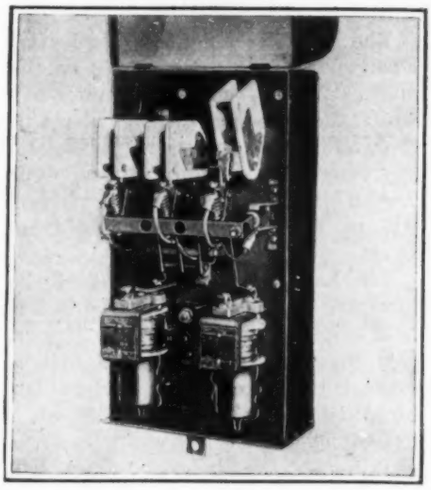
bolt is placed at the top of the machine. The head can be adjusted vertically to three positions and with a range of five inches.

These machines can be arranged as gang drills; they can be provided, if desired, with a pilot hand wheel, a tapping attachment, with belt drive, oil pump and grooved table.

Allen-Bradley Motor Starters

A line of across-the-line switches and resistance starters for induction motors has recently been placed on the market by the Allen-Bradley Co., Milwaukee, Wis. Resistance starters of both the automatic and semi-automatic types are included.

An across-the-line switch for use with push-button control is shown



Allen-Bradley Motor Starter

in the accompanying illustration. This device is available for use with squirrel-cage motors up to 25 hp. at 220 volts, 35 hp. at 440-550 volts, and with self-starting polyphase motors up to 50 hp. It is equipped with inverse time limit overload relays, no-voltage release, push button station, and copper-to-copper rolling contacts. The switch is enclosed in a steel cabinet and operates entirely from a push-button station with a stop and start button.

A semi - automatic resistance starter is also included in the series and provides stepless acceleration and smooth increase in starting torque without excessive starting current. Allen - Bradley graphite compression resistors are used and the motor is started by lifting the handle quickly to the mid-position, after which the handle is slowly lifted and the magnetic switch closes, throwing the motor on the line without opening the motor circuit. Arc shields and blowouts are provided on all phases.

The automatic resistance starter model of the line is a push-button control starter for squirrel-cage motors. The graphite compression resistors are adjustable for any starting current and there are no taps to change. The motor is started by pressing the push button, thereby closing the starting clapper switch and allowing the motor to accelerate

with the primary resistors in the main circuit. At the end of a fixed interval the timing relay closes the main clapper switch and throws the motor on the line without opening the primary circuit.

"New Tip" Soft Metal Hammer

The Bilton Machine Tool Co., Bridgeport, Conn., is putting on the market a soft-metal hammer in which the faces are die-cast pieces of lead, babbitt or similar material, and are renewable without difficulty or loss of time. New faces, or "tips," will be immediately available from stock.

The handle and lower half of the head are in one piece, and the cap is held in place by two machine screws. The material of which the tool is made is semi-steel. Renewal of battered tips involves only the withdrawal of the two machine screws, shaking out the tips to be discarded,

"New Tip" Soft Metal Hammer

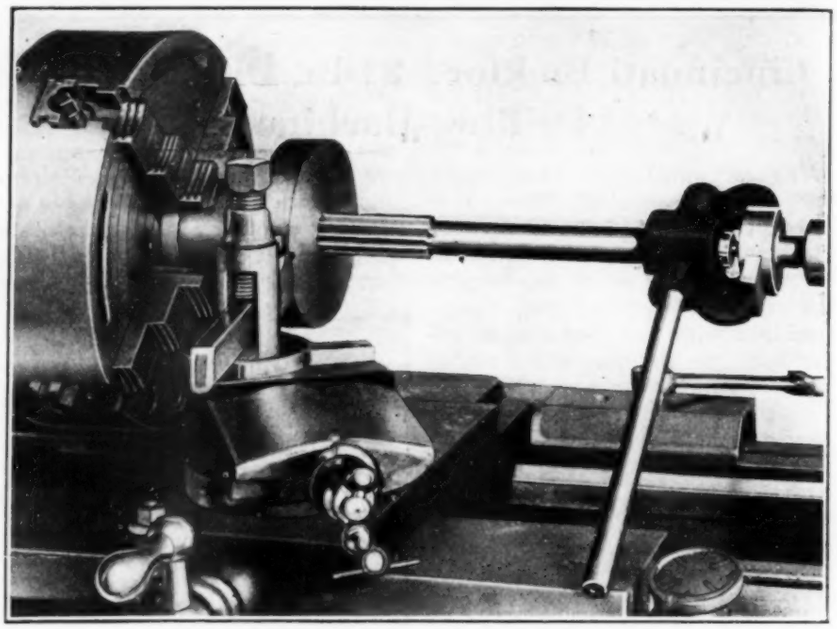
setting in new castings and replacing the screws.

Countersunk holes in the cap permit the machine screws which are of the flat head type to be set flush so that the head of the hammer is without projections of any sort.

The cavities in the head are accurately milled to gage and the dies in which the tips are cast are milled to similar gages, made with due allowance for shrinkage. The shoulders of the retaining grooves have a 5-deg. slope so that when the cap is tightened in place it bears upon these beveled shoulders, holding the new tips firmly to their respective seats and preventing any looseness. The beveled shoulders serve the further purpose of allowing a battered tip to drop easily out of the cavity when the cap has been removed. The hammers are made in 2-, 4-, and 6-lb. sizes.

Nicholson Drill and Reamer Holder

A drill and reamer holder has recently been brought out by W. H. Nicholson & Co., Wilkes-Barre, Pa. In the illustration it is shown in use on a lathe.



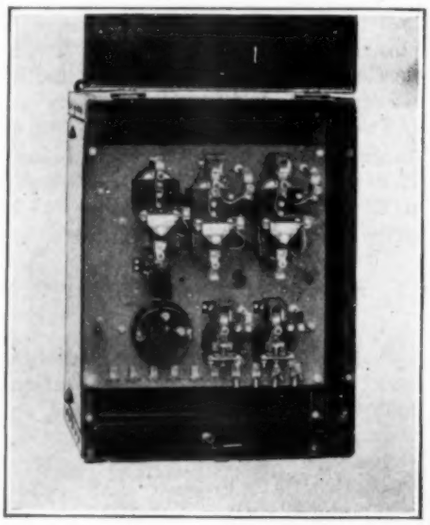
Nicholson Drill and Reamer Holder

The holder takes the place of the live center and acts as dog, driver and hold-back. It can be used in a drill press as well as in a lathe, taking the place of the regular chuck. It can also be used in the turret lathe and screw machine as a floating reamer holder. Hardened steel plates are provided to line up the drills and it is claimed for the device that bell-mouthed holes are reduced to a minimum.

The holder is furnished in any taper or straight shank required up to 1¼ in. in diameter.

G. E. Magnetic Machine-Tool Controller

A line of magnetic machine-tool controllers, employing the counter-emf. method of acceleration, has been placed on the market by the General Electric Co., Schenectady, N. Y. These controllers are applicable to reversing and non-reversing, constant and adjustable speed drives requiring normal starting conditions. They have been developed primarily for application to direct current motors in sizes ranging up to and including 15 horsepower.



G. E. Magnetic Machine-Tool Controller

The controller provides two accelerating points. The starting resistor is automatically short-circuited in one step upon proper acceleration of the motor. This result is accomplished by an accelerating contactor whose closing is governed by the counter-emf. of the driving motor of the tool.

Coincident with the adoption of this type of starter for its smaller motors, the company has redesigned its larger types of magnetic machine-tool and general-purpose controllers. A complete line of magnetic controllers for all kinds of machinery is thus rounded out.

News of the Week

Attendance Records Broken at American Railway Association Convention

Meetings and exhibits well attended

Despite the abnormally cool and wet weather at Atlantic City, the fifth annual meeting of the American Railway Association was the greatest, in point of attendance, of any of the railway association conventions since 1911. Total attendance at the close of the afternoon registration, June 14, was 4,665. The figures for similar periods in 1922, 1920, and 1919 were 3,724, 3,985, and 3,872. At this writing, the figures reached on the last day of the convention are not available.

The meetings of the first three days dealt with subjects of direct interest to the master mechanics and those of the last three to problems of the master car builders. The arrangement of the dates, Wednesday, June 11 to Wednesday, June 18, inclusive, allowed an intervening week end of which Saturday was devoted to the exhibits exclusively and Sunday to devotional services, recreation and sight-seeing.

Many Exhibits

The exhibits of railway supplies, appliances and machinery, under direction of the Railway Supply Manufacturers Association, were on a par with standards previously established and their number was so great that an overflow exhibit was held in a temporary annex across the board walk from Young's million dollar pier. If the number of inquiries received by the machine tool representatives may be used as a barometer, it would seem that railroad buying of equipment is to be increased.

The new chairman, elected for the term expiring June, 1925, is J. J. Tatum, Superintendent Car Department, B. & O. Ry. J. T. Wallis, Chief Motive Power, P. R. R. System, was elected Vice-Chairman. The members of the General Committee elected are as follows: Term expiring June, 1926: A. Kearney, Supt. Motive Power, Norfolk & Western R.R.; C. F. Giles, Supt. Machinery, Louisville & Nashville R.R.; L. K. Sillcox, Gen. Supt. Motive Power, Chicago, Milwaukee & St. Paul Ry.; J. Purcell, Asst. to Vice-President, Atchison, Topeka & Santa Fe Ry.; G. E. Smart, Chief of Car Equipment, Canadian National Rys.; C. E. Chambers, Supt. Motive Power and Equipment, Central Railroad of New Jersey; C. H. Temple, Chief Motive Power and Rolling Stock, Canadian Pacific Ry. Term expiring June, 1925: J. C. Fritts, Master Car Builder, Delaware, Lackawana & Western R.R.; O. S. Jackson, Supt. Motive Power and Machinery, Union Pacific R.R.; F. H. Hardin, Chief Engineer Motive Power and Rolling Stock, New York Central R.R.; W. H. Fetner, Chief Mechanical Officer, Missouri Pacific R.R.; A. R. Ayers, Asst. General Manager, New York, Chicago & St. Louis Railroad.

Of immediate interest to the machinery industry were the following addresses and papers: Opening address by John Purcell, chairman of the division and assistant to the vice-president of the Atchison, Topeka & Santa Fe; "The Modern Locomotive," by W. H. Winterrowd, assistant to president, Lima Locomotive Works; "Lehigh Valley Three Cylinder Locomotive No. 5000," by J. G. Blunt, American Locomotive Co.; "Proper Training of Shop Supervisory Forces," by L. W. Baldwin, president, Missouri Pacific Railway.

The following paragraphs are a brief abstract of Chairman Purcell's address:

"It was decided that this year's meeting should include exhibits, in order that the manufacturers might have an opportunity to demonstrate the improvements which they have made during the past two years. It appears that this practice of alternate business meetings and meetings with exhibits is a desirable one. There are not enough developments in one year to warrant the expense of exhibits each year.

Rehabilitation in 1923

"The year 1923 was a period of rehabilitation, and intensive efforts were made by all the railroads to put all of their power and rolling stock in first-class condition. As a result of these efforts, the railroads handled the largest volume of business in their history, in the most efficient and satisfactory manner. The bulk of this problem fell on the officials of the Mechanical Departments. They should be congratulated upon the showing which they made, though, of course, the Operating Departments played an important part in this achievement.

"The problem has now changed somewhat, business being considerably lighter. We are, therefore, passing into a period of limited retrenchment, though this retrenchment should not be carried to a degree that will result in impaired service to the public. Public sentiment towards the railroads has improved greatly during recent years and last year's efficient service helped strengthen this favorable sentiment. It would be disastrous if the condition of equipment is allowed to fall off to such an extent as to again arouse the animosity of shippers.

"We are also fortunate this year in having two papers on the development of new types of locomotives. The past year has been a notable one in the interest which has been shown in the improvement of the modern steam locomotive. The types which have been most extensively discussed are the 50 per cent cut-off locomotive, the three cylinder simple locomotive, and the booster-equipped locomotive. All of these types have certain features which warrant careful study by mechanical department officers.

"The Locomotive Construction Committee should keep in active touch with the work which is being done on these designs and the results which are secured in operating service, for after all, it is not only a locomotive with high thermal efficiency which we desire, but one that is also satisfactory from an operating viewpoint.

Changes in Locomotive Design Important

"A locomotive to be satisfactory must be able to get over the road without failures, and with a reasonable maintenance cost. These two factors are often overlooked by proponents of radical changes in design. There are two revolutionary changes in locomotive design, which are engaging the thought of many prominent engineers; these are the turbine locomotive and the Diesel locomotive. Our European neighbors have gone further in this work than we, due probably to the higher cost of their fuel.

"However, it is our belief that in the near future there will be designs of these types made by American engineers to suit the requirements of American railroading, which may revolutionize locomotive construction. It appears that the Diesel engine has reached the stage of perfection where it will in itself be a satisfactory unit of power, without undue weight.

"The transmission or coupling arrangement is, however, a stumbling block which has held back the development of this type of locomotive. New ideas are, however, now in process of development, which give promise of meeting all the requirements. Here again our Locomotive Construction Committee should follow up the developments and report all points of interest.

"Mechanical department officers should give careful thought to providing labor-saving machinery, as the returns on such investments are greater now than at any other time in railroad history. Adequate shops and modern machinery should be installed wherever financial conditions will permit.

"A new development in connection with financing additional facilities of certain types has been brought forward in the last few years, whereby the manufacturers will arrange for the financing of an installation on a plan somewhat similar to the equipment trust certificate system. This plan may prove of great assistance where a railroad's financial condition is such as not to permit of the immediate necessary expenditures."

EXHIBITORS OF MACHINERY

Among the exhibitors of the machinery and closely related products were: Air Reduction Sales Co., New York City; Ajax Mfg. Co., Cleveland, Ohio; American Crusher & Machinery Corp., New York City; American Tool Works Co., Cincinnati, Ohio; Armstrong-Blum Mfg. Co., Chicago, Ill.; Ashton Valve Co., Boston, Mass.; E. C. Atkins & Co., Indianapolis, Ind.; R. & L. Baker Co., Cleveland, Ohio; Bassick Mfg. Co., Chicago, Ill.; John Bath & Co., Inc., Worcester, Mass.; Charles H. Besly & Co., Chicago, Ill.; Black & Decker Mfg. Co., Townson, Md.; S. F. Bowser & Co., Ft. Wayne, Ind.; Boye & Emmes Machine Tool Co., Cincinnati, Ohio; Bridgeport Safety Emery Wheel Co., Inc., Bridgeport, Conn.; Bullard Machine Tool Co., Bridgeport, Conn.; Carbo-Oxygen Co., Pittsburgh, Pa.; Chambersburg Engineering Co., Chambersburg, Pa.; Chicago Pneumatic Tool Co., New York City; Chisholm-Moore Mfg. Co., Cleveland, Ohio; Cleveland Pneumatic Tool Co., Cleveland, Ohio; Cleveland Twist Drill Co., Cleveland, Ohio; Columbia Machine Tool Co., Hamilton, Ohio; Cone Automatic Machine Co., Inc., Windsor, Vt.; Consolidated Machine Tool Corp. of America, Wilmington, Del.; Davis Boring Tool Co., St. Louis, Mo.; Diamond Machine Co., Providence, R. I.; Henry Disston & Sons, Inc., Philadelphia, Pa.; Dreses Machine Tool Co., Cincinnati, Ohio; Eclipse Interchangeable Counterbore Co., Detroit, Mich.; Electric Arc Cutting & Welding Co., Newark, N. J.; Elwell-Parker Electric Co., New York City; Walter H. Foster Co., New York City; Foster Machine Co., Elkhart, Ind.; Gallmeyer & Livingston Co., Grand Rapids, Mich.; General Electric Co., Schenectady, N. Y.; Goddard & Goodard Co., Detroit, Mich.; Gould & Eberhardt, Newark, N. J.; G. A. Gray Co., Cincinnati, Ohio; Hanna Engineering Works, Chicago, Ill.; Hyatt Roller Bearing Co., Newark, N. J.; Independent Pneumatic Tool Co., Chicago, Ill.; Ingersoll Milling Machine Co., Rockford, Ill.; Jones & Lamson Machine Co., Springfield, Vt.; K-G Welding & Cutting Co., Inc., New York City; Keller Mechanical Engineering Corp., Brooklyn, N. Y.; William H. Keller, Inc., Grand Haven, Mich.; King Pneumatic Tool Co., Chicago, Ill.; Landis Machine Co., Waynesboro, Pa.; Lapointe Machine Tool Co., Hudson, Mass.; Latrobe Tool Co., Latrobe, Pa.; Lehmann Machine Co., St. Louis, Mo.; Link-Belt Co., Chicago, Ill.; Lucas Machine Tool Co., Cleveland, Ohio; Manning, Maxwell & Moore, Inc., New York City; Metal & Thermit Corp., New York City; Morton Mfg. Co., Muskegon Heights, Mich.; National Machinery Co., Tiffin, Ohio; Nazel Engineering & Machine Works, Philadelphia, Pa.; Niles-Bement-Pond Co., New York City; Ohio Machine Tool Co., Kenton, Ohio; O. K. Tool Co., Inc., Shelton, Conn.; Oxweld Railroad Service Co., Chicago, Ill.; Peerless Machine Co., Racine, Wis.; Henry Pels & Co., Inc., New York City; Potter & Johnston Machine Co., Pawtucket, R. I.; Pratt & Whitney Co.; New York City; Production Machine Co., Greenfield, Mass.; Racine Tool & Machine Co., Racine, Wis.; Schroeder Tool Co., Altoona, Pa.; S. K. F. Industries, New York City; Skinner Chuck Co., New Britain, Conn.; Southwark Foundry & Machine Co., Philadelphia, Pa.; Springfield Machine Tool Co., Springfield, Ohio; L. S. Starrett Co., Athol, Mass.; Swind Machinery Co., Philadelphia, Pa.; Thomson Electric Welding Co., Lynn, Mass.; Timken Roller Bearing Co., Canton, Ohio; Torchweld Equipment Co., Chicago, Ill.; H. B. Underwood Corp., Philadelphia, Pa.; Universal Machine & Tool Co., Canton, Ohio; Walworth Mfg. Co., Boston, Mass.; Warner & Swasey Co., Cleveland, Ohio; Williams Tool Corp., Erie, Pa.; Yale & Towne Mfg. Co., Stamford, Conn.

Prominent Speakers Heard at Meeting of Green Mountain Section of A. S. M. E.

Guy Hubbard is elected chairman for the coming year

The second meeting of the Green Mountain Section of the A. S. M. E. which was organized at Windsor, Vt., last fall during a joint meeting with the Vermont Society of Engineers, was held on June 6 at Windsor, Vt.

ELECTION OF OFFICERS

Following the dinner, a business meeting was held. Edward Robinson, head of the Department of Mechanical Engineering at the University of Vermont, and chairman of the Green Mountain Section, presided at this meeting. The following officers were elected for the coming year: Guy Hubbard, Windsor, Vt., chairman; Frederick Holdsworth, Claremont, N. H., vice-chairman; and Daniel H. Parker, Windsor, Vt., secretary and treasurer. An executive committee consisting of: Past-Chairman Edward Robinson, Burlington, Vt.; Henry C. Belcher, Proctor, Vt.; and Joseph B. Johnson, of Springfield, Vt., was elected.

PROF. BRECKENRIDGE TALKS

After the election of officers, Prof. Robinson introduced the speaker of the evening who was Lester P. Breckenridge, Professor-Emeritus, of the Sheffield Scientific School of Yale University. The subject of Prof. Breckenridge's talk was "What the Mechanical Engineer Can Do for Vermont," and with his usual success he kept his hearers intensely interested for nearly an hour.

Following Prof. Breckenridge, Ex-Governor James Hartness of Vermont, President of the American Engineering Council, was called upon, and gave his views on what the Green Mountain Section might do. Governor Hartness suggested that meetings be held between spring and fall, in different industrial sections, so that the inhabitants of these sections might become acquainted with each other, and with the work their associates are doing.

THE OTHER SPEAKERS

Other speakers of the evening were Ralph E. Flanders, general manager of the Jones & Lamson Machine Co. of Springfield, Vt., and Henri A. Sèvigné, general manager of the National Bread Wrapping Machine Co., at Nashua, N. H.

A report on the Spring Meeting of the American Society of Mechanical Engineers held at Cleveland was presented by Guy Hubbard.

On Saturday morning a number of those who attended the meeting were the guests of the Sullivan Machinery Co. at an inspection of the plant in Claremont, N. H., and at a luncheon. Mr. Holdsworth, the chief engineer of this company, was the host.

Report Shows Gain for Fischer Body Corporation

That the three months, February, March and April this year, comprised the most profitable fiscal quarter in the history of Fisher Body Corp., is indicated by the company's annual report for its year ended April 30, 1924. Net profits in this period were $6,419,239 after all charges or nearly $500,000 more than the total annual dividend requirement of $10 a share on the 600,000 shares of stock.

While the prosperity of the automobile industry last year is partially responsible for the steady gain, a more direct influence in quadrupling earnings in the past two years has been the tremendous expansion program laid out by the corporation to place it in position to secure full benefits under its contract for supplying bodies to the General Motors Corp. Under this program the $16,749,574 was expended last year enabling the corporation to supply General Motors with practically all its body requirements where only a few years ago it could handle less than 10 per cent of this business.

Total earnings of Fisher Body Corp., after taxes last year were $22,102,008, equivalent to $53.73 a share. In 1922-23 was $17,172,176, or $33.98 a share on 500,000 shares of stock after preferred dividends. For the past two years the corporation has included earnings of Fisher Body of Ohio of which it owns about 98 per cent. This company last year added nearly $4,000,000 to Fisher's net.

Mack Trucks, Inc., Plans Summer Expansion

Wider use being made of the motor bus has considerably enhanced the prospects of Mack Trucks, Inc., this year. The company is planning an extensive development of its passenger carrying bus business with the introduction of new models this summer.

According to officials, business to date has exceeded earlier expectations, and earnings have been running only slightly behind the record-breaking totals of the first two quarters of 1923.

No small credit for bringing Mack Trucks, Inc., in less than two years from a practically unknown factor in the motor truck industry to a leading position is due to the company's management and the conservative policy of turning the bulk of earnings back into the property. The effect of this policy is clearly indicated by the company's balance sheet of March 31 which shows current assets of $28,926,962 against current liabilities of $3,839,500 or a ratio of better than seven to one. Net quick assets of $25,087,462 are equivalent to the par value of the company's $16,000,000 of preferred stocks with a balance of more than $30 a share on the common. Aside from this strong liquid position, the company carried a surplus of $18,836,508 which represents largely recent earnings returned to the property.

Baldwin Production Is Improving

Operations at Baldwin Locomotive Works have passed the 40 per cent mark to which they were increased at the beginning of the month and by July 1 it is stated the rate will be up to 50 per cent. Notwithstanding steadily expanding operations with increasing shipments, unfilled orders hold around the $10,500,000 mark which is more than double where they stood at the beginning of the year. Operations at Standard Steel Works remain satisfactory and this subsidiary has booked 70 per cent of its budget for the year to date.

President Vauclain has left for Mexico City. In addition to booking orders for 50 locomotives from Mexican National Railways, he has been negotiating for purchase of other railway equipment.

Valuable Machinery Is Tied Up in China

An Associate Press dispatch from Canton, China, states:

"Friction continues over the alleged attempted resale of the arsenal machinery held here by the Rabbitt Engineering Co. as security for the unpaid portion of the original purchase price.

"Action of the South China government in invoking the Chinese arms embargo agreement, to which the United States has become a party since the original sale of the arsenal machinery has been followed by posting on the warehouse where the goods are stored of a notice by the United States consul stating that the machinery is American-owned.

"In addition, the engineering company inserted a letter in the newspapers, asserting that the government, the purchaser of the machinery, has repudiated its purchase contract, since delivery had been made in part, and that the payments made on the machinery still held were hardly sufficient to cover the interest on the money so tied up.

"In the meantime, of course, the vendors are helpless; they cannot remove the machinery from Canton because of the embargo. The government insists that there is no intention on its part to refuse payment of the balance due on the machinery. According to a government statement, the amount due is $400,000 gold out of the original purchase price of $1,600,000 gold."

Spain Would Keep Out Foreign Industries

The Barcelona committee of the Federation of Spanish Industries, where is centered the chief machinery in metal working trades of that country, has sent the Spanish dictator, General Primo de Rivera, a message in which it is claimed that Spanish industry alone can take care of the development of the country in all industrial lines and in the organization of new industries, to the extent that Spain can be independent of outside interests. The Federation insists that no further industrial or mining concessions be granted foreign companies and that the recent commercial treaty concluded with France shall be denounced as speedily as possible.

The real significance of this is in the underlying protest against the infiltration of Krupps recently in the metallurgical industry of Catalonia (Barcelona) and the Vickers-Maxim English group in the Northwest district of Spain.

Southern Pacific Buys El Paso Road

Confirmation of the acquisition of the El Paso & Southwestern railroad by the Southern Pacific Co. was made in statements issued by J. Kruttschnitt, chairman of the executive committee of the Southern Pacific, and T. M. Schumacher, president of the El Paso & Southwestern. An addition of 1,140 miles of railroad is thus made to the present Southern Pacific system of 11,223 miles.

Plan Joint Meeting of Foundrymen

The New England Foundry Association has invited the Newark Foundry Association and the Philadelphia Foundrymen's Association to be its guests at a joint meeting to be held in Boston, July 18. Inspection tours and discussions besides entertainment have been planned and it is expected that the meeting will prove to be most successful.

Southern Iron Output Near Record

The May output of iron by the furnaces in the Alabama territory was the largest single month in several years with the exception of March, 1923, total production in May reaching 249,268 tons. This is much larger than normal production, and with the iron output of the Alabama furnaces for the first five months of the year now 1,156,647 tons, there is ample indication that 1924 will prove an entirely satisfactory year.

In other sections of the South, according to the Southern Metal Trades Association, the industry also is operating on an increased basis, though foundries and machine shops outside the Alabama territory are not reported as active as they might be.

However, the association considers the summer outlook satisfactory, with all indications portending a considerable increase in foundry and machine shop activity during the next few months, and a full return to normal production by the early fall.

Pusey & Jones Plant Will Be Sold

The war plants and ship building yards erected at Gloucester, N. J., by the Pusey & Jones Co., are to be sold at Receivers' auction by order of the District Court of the United States.

The sale will be held by Joseph P. Day, on Thursday, June 26, at 2 o'clock, daylight saving time, in the Administration Building.

The Pusey & Jones Co. plant consists of 179 acres of land, a number of brick and steel manufacturing and administration buildings, a power plant, machinery, cranes, equipment, etc.

American Taxi-Meters Will Be Made in France

A new company to be known as Taximetres et Mecanique de Precision has been launched at Paris for the construction and sale of precision tools and appliances, notably a new taximeter. Capital is 500,000 francs, of which 200 shares of 500 francs each are held by the American Taximeter Co. of New York City and as director of the company is mentioned Monsieur Francois Ducasse, of 325 St. Mark's Place, New York.

Two Hundred Thousand Fords Sold in May

The Ford Motor Co. sold 209,601 cars and trucks in May, according to figures published recently. Lincoln sales for the month broke all records with a total of 868 cars sold, or 106 more than in April, which previously was the record month. Tractor sales averaged more than 300 a day for the month. May was the third consecutive month in which the Ford sales exceeded the 200,000 mark. In March the company sold 205,000 cars and in April 211,000.

Other companies reported that the retail sales of automobiles had increased in the last two weeks.

The Business Barometer

This week's outlook in Commerce, Finance, Agriculture and Industry based on current developments

By Theodore H. Price
Editor, *Commerce and Finance*, New York

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THE GOLDEN flood that has for so long been impounded in the Federal Reserve Banks is at last being released. The New York and Boston banks reduced their discount rate to 3½ per cent last Wednesday. Their action is in part explained by the weekly statement of the Federal Reserve System, which shows a gain of $30,000,000 in gold, a reduction of $12,000,000 in earning assets and a reserve ratio of 82.4 per cent.

Call money is in abundant supply and almost unlendable at 2 per cent. Three months loans are freely offered at 3½ per cent. Bankers' acceptances running for six months are salable at 2½ per cent and for almost the first time in history interest rates in New York are lower than in London.

The first effect of the decline in money was an advance in security prices. The United States Treasury was able to sell $150,000,000 of its six months certificates at 3½ per cent. All the Liberty issues have made new high records. Other bonds have shown an advancing tendency and the better class of stocks, including the rails in particular, have moved upward. More is now being heard of the various railway consolidations upon which bankers have been incubating for so long and it is quite possible that some of them will take definite shape in the near future.

The stocks of the public utility companies have also been in demand. Their earnings are excellent and the market for them has been greatly enlarged by the efforts that the companies have made to sell their securities to those who use their service.

The Republican convention at Cleveland has really attracted but little attention. The nomination of Mr. Coolidge was foreordained and the candidacy for General Chas. G. Dawes for the vice-presidency has evoked neither enthusiasm nor criticism.

It remains to be seen whether the nominations made by the Democrats will be as phlegmatically received, but the political hysteria by which so many business men were afflicted a few months ago seems to have passed and most people are now willing to believe that the country will be safe no matter who is elected.

The optimism that cheap money has inspired on the Stock Exchange has not yet spread to the commodity markets or the distributive trade of the country, but there are some indications that they are beginning to feel its influence. All the cereal staples, including rye, corn and oats, as well as wheat, are higher. The advance is ascribed to a Government report on the wheat crop that indicates a total yield of only 693,000,000 bu. as compared with 786,000,000 bu. last year and 1,025,801,000 bu. in 1915. But the Government's figures on rye and oats were not especially bullish and it is plain that the upward tendency was more the result of speculative infection than of an expected or indicated shortage in supply.

The same thing is true of cotton. There was nothing in the news to suggest a change in the crop outlook, but the decline in progress up to Tuesday evening has been arrested and the market turned upward again on Wednesday.

Distributive trade is about normal, but dealers in cotton goods and woolen fabrics report more inquiries. The production of and demand for steel are both at a comparatively low ebb, but nearly all the trade oracles are agreed that August will see an improvement.

Silk is still "in the dumps," but it has stopped declining and may start up again unless the cotton manufacturers succeed in re-popularizing their product by the advertising campaign for which they are planning. Rubber is firmer and even automobiles are selling more readily.

Bank clearings continue to challenge the assertions of the misanthropic by running ahead of last year. Railroad car loadings indicate a traffic movement that is at variance with the alleged business prostration, and savings deposits as well as the life insurance business bespeak an unusual degree of prosperity and thrift.

A little more unemployment is reported in some industries and some localities, but the labor released will soon be needed in the harvest fields and by the time the crops are housed the wheels of industry will probably be running at full speed again under the stimulus of cheap money.

I confess to some satisfaction in an outlook so manifestly cheerful as it confutes the predictions of the pessimistic friends who recently took me to task for being optimistic. It is true that the abnormal activity in building has been halted, but the effect will be salutary, as construction at the highest cost on record was being overdone.

It is also true that France is passing through one of the political crises to which she seems accustomed. But the outlook abroad is otherwise encouraging. The "brain storm" provoked in Japan by our immigration bill appears to be subsiding. The Germans have accepted the Dawes report, Russia seems to be gradually re-establishing the capitalistic regime and unless America takes fright at the political ghosts that will stalk abroad during the presidential campaign there is no reason why we should not speedily recover our poise and our prosperity.

What's Doing in Industry

From most machinery and machine tool centers in the United States comes the report that business has not improved. So far the month of June has not differed greatly from April and May and prognosticators say that unless railroad buying improves and automobile production is stabilized, July will not present any more business than the three preceding months.

Railroads, locomotive shops and allied industries show a decided improvement with their securities selling better and business keeping up very well. Automobile production is on a par with that of last year, but a pessimistic tone obtains in this market which somehow cannot be dispelled.

Industrial building activity has not materially changed. It increased slightly during the first week of June and decreased slightly during the second week. The same movements were also recorded for the same weeks in 1923.

Makers of electrical equipment and supplies report that business is keeping up and that the totals for the year will equal the totals for 1923, which was a record year in this field.

The stock market has shown a decided strengthening with railroad stocks in the lead. The volume of sales in Wall Street has also improved as compared with that of either the week before or two weeks before.

Industrialists seem well pleased with the results of the Republican convention and approval of the Coolidge-Dawes ticket is the general sentiment. Just what influence politics will have on business is yet to be seen; responsible prohpets claiming that so far it has had none and that declines have been due to other causes.

The Industrial Review

Progress of the machinery and machine-tool business in various parts of the country

THE following reports, gathered from the various machinery and machine tool centers of the country, indicate the trend of business in these industries and what may be expected from the future:

New York

No material improvement has been observed in the New York district in the sale of machinery or machine tools. However, the business is not as bad as some would expect and the only point to emphasize is that there has been no improvement. General industrials, big electric companies, and railroads are buying necessities and inquiries are coming in at a fairly good rate. If automobile makers start buying during the latter part of June or in July, business will materially improve. Otherwise, it will probably keep to the same level it is now.

Used tool merchants have no complaint to make. Since March they have been kept busy which is usually the case when there is a falling off in new business. However, they do not look for the second half of the year to be as good as the first.

Exporting has kept up surprisingly well although this, too, is due for a dropping off which will not be unexpected in July.

Purchases of machine tools by the Erie railroad are expected shortly and lists are being prepared, it is understood. This road will improve its shops over the summer and fall months, it is stated upon good authority, and a considerable sum will be expended.

Locomotive builders have been inquiring lately for tools and some few orders have been placed in the New York market.

Indianapolis

In the face of rather adverse conditions, the machine tool and machinery trade appears to be holding its own in Indiana. In fact there are some bright spots in various industrials that would lead to the belief that the present decline in business is to be of short duration. According to O. B. Iles, head of the International Machine Tool Co., business is slow, but the general situation seems to be sound and he has no fear for the future of business during the last half of the present year.

With the machine tool trade, the volume has been reduced by the disappointing production of the local automobile factories and allied industries. Production has been cut to a minimum and there seems to be no future for the industry at least until fall. On the other hand the fabricating plants here, who specialize in structural steel and steel for reinforcing, report a good business. The Hugh J. Baker Co. reports a volume of business within ten per cent of the same six months of last year. Prospects for the next two or three months, however, officials report, are not the best.

Machinery houses who deal in textile machinery report the demand from this source fair. It seems that in spite of the Eastern situation, Indiana textile mills are keeping fairly busy and expansions in some plants are in progress. Railroads are confining their purchases both of machinery and machine tools to actual requirements. The local trade reports a fair volume of business from the railroad car factories. It seems that during the first few months of the present year, factories in Terre Haute, Jeffersonville and other cities secured some rather large contracts that have kept them fairly busy so far this year and probably this will continue for another month.

Canada

Demand for machine tools in Canada is still confined largely to immediate requirements and orders for small lots. Trading in the metal markets generally has been lagging for several weeks now. The satisfactory steel production record of April and the first half of May is being followed by news of a slackening of the output. Unless further rail business is placed in the near future there will be an important decrease in steel production. Likewise the car builders are dependent on further equipment orders in order to maintain production at an active rate.

Gradual Slowing Up

Construction activity has also slowed up and manufacturers of building materials complain of lack of business. Railway traffic, as indicated by car loadings, is fairly well maintained at a better rate than for the corresponding weeks of last year. The automobile industry is well employed and production in this line is more satisfactory than in most other lines. Though the General Motors plants in Oshawa, Ontario, have been very busy all winter and shipments have been heavy each month, it was left to April to set up a new record when 4,755 cars of all models were shipped. The opinion has been expressed by J. B. Thompson, former general manager of General Motors Export Co. of Canada, now attached to the parent corporation, that the Canadian plant will have more export business than ever in spite of the removal of the McKenna duties in England. This would indicate that the company will continue to handle a big percentage of export business from Canadian plants.

As was to be expected, the Canadian Manufacturers Association at their annual meeting in Montreal strongly protested the recent lowering of the tariff on some lines and urged higher tariffs to meet the increasing competition from European low wage and depreciated currency countries. Arrangements are in the making by the association for an active educational campaign to secure rigid adherence to a policy of tariff protection for Canada.

The annual statement of the Canadian National Railways presented to Parliament showed net operating revenues on all lines during last year as $21,187,000, compared with only $3,993,000 in 1922. The railways of Canada, as a whole, from the beginning of this year to the end of April earned $6,000,000 more than they did during the corresponding period in 1923, according to their report.

Southern District

Regarded as a whole, machinery and tool sales in the Southern territory continued rather quiet during the first ten days of June, though the period was slightly better than the first ten days of April, and sales continue to show a little improvement over the corresponding period of last year. Conditions, however, have a tendency to be spotty, some lines in good demand, others quiet. The first half of the year, however, January to June inclusive, will show up favorably as compared with the first half of 1923, with the gross volume of sales probably ranging from 6 to 8 per cent better, with some larger distributors enjoying a 10 to 12 per cent increase.

Principal buyers at this time are railroads, road builders and the automotive industry, with export sales quite active.

Textile industries of the South have curtailed production still further during the past two weeks, and the expected increases in sales of equipment to this source have not as yet materialized. Inquiries, after showing improvement the latter part of May, have fallen off again, and little business is reported. The outlook is unsatisfactory, and though the trade is hopeful for betterment this summer, there is by no means any certainty of it.

New Business in the South

A considerable amount of new industrial construction is being reported from all parts of the South, with service stations, lumber enterprises and woodworking plants leading the field, creating a fairly good potential market that is resulting in a good share of the business that southern dealers are now enjoying. There has also been a large amount of new construction in the foundry and machine shop industries in the South, and slight improvement in tool and equipment buying by the latter has been lately noted, though much of the business is in used equipment.

Present indications are that June sales will be about on a par with those

of April and May, showing a little improvement over the same month in 1923, with present inquiries large enough to indicate that July business will at least be as large as that of June.

Milwaukee

The local machine tool market has found signs of encouragement in a revival of inquiry for prices and delivery dates on some important items in the past week or two, these relating to special high-efficiency types of metalworking machines. Standard tools are moving very slowly, and as a rule stocks in various positions are fully ample to take care of the current demand. This makes the production situation very uneven and continues to tend toward an unsatisfactory basis of operations.

Dealers are meeting a moderate call for equipment, but like the manufacturers, find no volume in trade. Nearly all sales are of single items, with here and there an order for two or three tools of different kinds, but usually of the light type for small users. Sales to automobile service and repair shops have improved since the close of May, a month in which many automobile dealers were marking time and retrenching in every way to await developments in the general situation.

It is a matter of comment in the tool trade that the lack of cancellations of orders throughout the recent period of quietude must be accepted as a healthy sign. Ordinarily such a condition is accompanied by a wholesale movement against taking deliveries promptly, or requesting makers and dealers to erase orders, but this has not developed and so far as can be ascertained, there has not been a suggestion in this direction.

The situation of the railroads, especially so far as those operating and maintaining construction and repair shops in Milwaukee and Wisconsin are concerned, is disappointing in view of the almost utter absence of new equipment buying. Several of the smaller shops have been shut down for the present, and retrenchment has been carried to the extent where the tool trade is getting practically no new business.

Export demand for equipment has held up surprisingly well, compared with the decline in domestic trade. Probably the best buyers are Japanese interests, with Australia and New Zealand also more prominent than European nations.

Detroit

Noticeable improvement in market conditions in the machine tool and machinery field in Detroit has featured the past week.

Everywhere business is picking up, leading men in the field declare, and already June bids fair to far surpass May's sales record which was far from being a bad month. Conditions are spotty in some sections, but for the most part dealers have no hesitancy in asserting that the outlook is much brighter than for some time.

The next sixty days will see many changes in engine and body design among the automobile companies centering here.

Just now there appears to be a rush of machine tool men to Detroit as plants are in the process of preparing for changes in models. Several large jobs are being undertaken at present.

Building statistics, employment figures, and bank statements bear out the solid prosperity to be found in every line in Detroit.

Frank B. Gilbreth Dies Suddenly

Frank B. Gilbreth, perhaps the best known consulting management engineer in the world, died of heart disease on Saturday, June 14. Mr. Gilbreth had just finished telephoning his wife from the railroad station of his home town, Montclair, N. J., when he was overcome. Only the members of his immediate family and a few close friends and neighbors were present at the quiet service held the following day from his home. He is survived by his wife and business partner, Lillian M. Gilbreth, and their eleven children. Mr. and Mrs. Gilbreth had planned to sail June 19 for the World Power Conference in London and the International Management Conference at Prague. Mrs. Gilbreth is planning to sail as scheduled to meet the many business and professional engagements that had been made. A more extended account of Mr. Gilbreth's life and work will be published later.

H. M. Swetland Passes Away

Horace Monroe Swetland, president of the United Publishers' Corp., and of the Class Journal Co., died Sunday afternoon, June 15, at his home at Montclair, N. J. He had been ill several months. Mr. Swetland had a wide acquaintance in the publishing field and in the industrial fields served by his papers. Funeral services were held at his home on Tuesday afternoon at 3:30 and burial was at Fredonia, N. Y., the following morning. A more detailed statement of his career will appear later.

Obituaries

JAMES P. O'DOHERTY, aged 55 years, purchasing agent of the Ottawa Car Co., Ottawa, Ontario, died recently.

THOMAS A. DUFF, aged 55 years, director of the Midland Iron & Steel Co., Ltd., died recently at his residence in Toronto.

LIEUT. COL. WILLIAM HENDRIE, president of Hendrie & Co., railroad contractors, and vice-president of the Hamilton Bridge Works, died at his home in Hamilton. Colonel Hendrie was a director of several other large corporations.

CURTIS L. MOORE, formerly manager of the Dominion Road Machinery Co., Ltd., Goderich, Ontario, died recently. Mr. Moore was born at Butler, Pa., in 1866. For a time he resided in Lima, Ohio, where he was manager of a foundry for J. Phillips, who was president of the American Road Machinery Co.

FREDERICK SKELTON, aged 79 years, managing director Canadian Shovel and Tool Co., died June 8 at his residence in Hamilton, Ontario. Mr. Skelton was born in Sheffield, England.

FRANK SPAULDING, aged 82 years, died recently in Providence, R. I. Mr. Spaulding was formerly connected with the Brown & Sharpe Manufacturing Co., having spent his active years since 1882 with that company. He was an expert on micrometer calipers and has designed many models.

B. FRANKLIN PAIST, aged 70 years, formerly night superintendent of the Baldwin Locomotive Works, died recently. Mr. Paist had been with the Baldwin company for 48 years.

Personals

WALTER F. HENLY has been appointed New York sales representative of the Hendey Machine Co., Torrington, Conn., succeeding ARTHUR H. HALL, who has been made sales manager. Mr. Henly has been the New York representative for the Leland-Gifford Co., Worcester, Mass., for several years.

A. F. HATCH, head of the Stanley Works of Canada, Ltd., Hamilton, Ontario, was elected president of the Canadian Manufacturers Association at the recent annual meeting in Montreal.

CARL J. SHERER, formerly secretary and treasurer of the Dayton-Wright Co., has been appointed a special assistant to G. M. Williams in the management and financial control of the Nordyke & Marmon Co. of Indianapolis, of which Mr. Williams is president.

DR. ARNIM ENGLEHARD, a member of the firm of Colet & Englehard, Offenbach au Main, Germany, is visiting this country and will return to Germany July 12. He is visiting machine tool builders and expects to accept several lines for representation in Germany. Mail will reach Dr. Englehard if addressed in care of R. S. Stokvis & Zonen, 1521 Whitehall Building.

H. A. SPARROW has joined the Robert June Engineering Management and Industrial Advertising Organization of 8938 Linwood Avenue, Detroit, Michican. Mr. Sparrow has served in the capacity of assistant sales and advertising manager of the London Steam Turbine Co., of Troy, N. Y., and later as plant engineer with the New York Telephone Co., of Brooklyn.

J. T. POWELL has been appointed factory sales manager of the Flint Motor Co., with headquarters at the plant in Flint, Mich.

SPRAGUE L. CHAPIN, chief of maintenance of the Dunlop Tire & Rubber Co., Buffalo, N. Y., has resigned. WILLIAM COURTNEY, his assistant, has been appointed to succeed him. Mr. Courtney was formerly head of maintenance of the Sparrows' Point plant of the Bethlehem Shipbuilding Co. Mr. Chapin has become associated with a wire manufacturing concern of Norwalk, Conn.

H. A. ADAMS has returned to the United States after spending four years in India. He represents the Walworth International Co. which is the exporting company for the Walworth Co. Boston, Mass.

GEORGE E. BELL, formerly assistant to the president of the Dominion Engineering Works, Ltd., has joined the staff of the Seaman Kent Co., Ltd., Toronto.

BEN W. BEYER, JR., has left his position with the Union Specialty Machine Co. in Chicago to accept a position with Industrial Works, New York City.

SENATOR N. CURRY, chairman of the board of directors of the Canadian Car & Foundry Co., Ltd., who has been making an extended tour around the world, has arrived back at his home in Montreal.

J. O. BAILEY will have charge of the newly opened branch office of the Chicago Pneumatic Tool Co., New York, in Dallas, Texas. The office will be located at 210 S. Jefferson St.

H. B. LYALL, secretary-treasurer of the Manitoba Bridge & Iron Works, Ltd., was elected chairman of the Prairie division of the Canadian Manufacturers Association, at the annual meeting.

N. H. VAN SICKLEN has resigned as vice-president and general manager of the Apperson Brothers Automobile Co., Detroit, Mich.

D. L. STOREY has been appointed sales manager of the Hamilton Stove & Heater Co., Ltd., Hamilton, Ontario. Mr. Storey was formerly associated with the Gurney Foundry Co. of Toronto.

Business Items

The Ramsey Chain Co., Inc., Albany, N. Y., has just announced the appointment of the Morse Engineering Co., 549 West Washington St., Chicago, Ill., as its Chicago representative.

The directors of the Mack Trucks, Inc., have appropriated three and a half million dollars for new plant and equipment for the manufacture of auto buses.

According to reports received in New York, another large order of machine tools has been received from the Mexican railways. Other lists are said to be out from this source.

The Horton Steel Works at Bridgeburg, Ontario, whose plant was badly damaged last December, have practically completed reconstruction and will shortly resume production on a large scale.

The property and buildings of Motor Trucks, Limited, Brantford, Ontario, now owned by the United States Government, are being offered for sale by sealed tender closing June 26.

The Florida Machine & Foundry Co., of Jacksonville, Fla., has been organized and incorporated with $500,000 capital, for the operation of a general foundry and machine shop business, according to the charter application. Franklin G. Russell, 950 Riverside Ave., Jacksonville, is named president of the company, and O. M. Smith, also of Jacksonville, secretary.

The Hartford Tool & Machine Co., of Hartford, Wis., a partnership, has been dissolved. John Meser is retiring and the business will be continued by Fred F. Jordon, who is moving the shop to larger quarters.

The partnership between Anton R. Larsen and Jacob H. Gottsacker, operating as the Excelsior Tool & Machine Co., 606 Belmont Avenue, Racine, Wis., has been dissolved as of June 1. The business is being continued in the present quarters by Mr. Larsen.

The annual convention of the sales representatives of the Buffalo Forge Co., Buffalo, N. Y., and its associated companies, which include the George L. Squier Manufacturing Co. of Buffalo, the Buffalo Steam Pump Co. of Tonawanda, N. Y., and the Canadian Blower & Forge Co. of Kitchener, Can., will be held at Buffalo the week beginning Monday, June 23.

The Barrett-Cravens Co., Chicago, Ill., is doubling its present capacity by building four more stories to its building.

Messrs. Spear and Jackson of Sheffield, England, manufacturers of saws and tools, have purchased the plant of the Aetna Saw Co. on Industrial Island, British Columbia. Extensions will be made and the present name of the company continued.

The building, real estate and other property of the Montana Tractor Co., at Oconto, Wis., will be offered for sale at public auction on July 14 to satisfy judgments held by the Reliable Tractor & Engine Co. and another creditor. These amount to less than $2,000, and efforts are being made to satisfy the demands before the day of the sale.

The Milwaukee Die & Tool Co., 136 Reed St., Milwaukee, has changed its corporate title to Advance Tool & Die Casting Co. This has been done to better express the character of its present business, which includes die castings as well as making tools, dies jigs, fixtures, etc. Louis F. Picker is secretary.

The Ragsdale Rotary Engine Co. was granted a charter at Jackson, Miss. The company has a capital stock of $500,000. It will manufacture rotary engines. Incorporators named are W. A. Ragsdale, of Jackson, Miss.; I. J. Brunson, of Columbia, Miss., and V. E. Hartsog, of Meridian, Miss.

John I. Thornycraft & Co., Ltd., engineers and shipbuilders of London, Babingstoke and Southampton, England, have established a Canadian branch in Montreal for the purpose of assembly and sales of commercial motor trucks and marine engines.

Trade Catalogs

Milling Machines. Kearney & Trecker Corp., Milwaukee, Wis. "Production Service" is the title of this booklet that has recently been mailed to the trade. It takes up milling and milling machines and contains many valuable hints for this kind of work. There are blue prints, half-tones and line cuts used for illustrations.

Small Tools. The Brown & Sharpe Manufacturing Co., Providence, R. I. Catalog No. 29 covers the small tools; prices, sizes and varieties are given. Included will be found full data for the sizing and cutting of gears.

Electric Drills. The Independent Pneumatic Tool Co., Chicago, Ill. Catalog No. 14 contains illustrations and descriptions of the line of electric drills, tapping machines and screw drivers made by this company. Complete information, including capacity, speeds, weights, tapping capacities, screw-driving capacities and current required, is given. All parts included as standard equipment are listed with each description.

Steel. The Jessop Steel Co., Washington, Pa. Tool steels and other raw materials of interest to machine tool builders are described in this little booklet. There are many valuable tables for production men to be found in the booklet.

Welding and Cutting Apparatus. The Burdett Manufacturing Co., 309 St. John's Court, Chicago, Ill. Oxy-acetylene and oxy-hydrogen welding and cutting apparatus are discussed in this pamphlet. The various products of this company and the work that each will do are described.

Chucks. The Graham Manufacturing Co., Providence, R. I. Circular H describing the pressed steel grinder chuck with a diagram and dimensions has been issued by this company.

Export Opportunities

The Bureau of Foreign and Domestic Commerce, Department of Commerce, Washington, D. C., has inquiries for the agencies of machinery and machine tools. Any information desired regarding these opportunities can be secured from the above address by referring to the number following each item.

Automatic machines for making watch and optical goods screws. Berlin, Germany. Purchase. Reference No. 10,455.

Machinery and machine tools. Budapest, Hungary. Purchase and agency. Reference No. 10,460.

Wood split and wrought iron pulleys. Cork, Ireland. Agency. Reference No. 10,450.

Complete sawmill machinery and equipment. Rio de Janeiro, Brazil. Purchase. Reference No. 10,453.

Forthcoming Meetings

American Society for Testing Materials. Twenty-seventh annual meeting, Chalfonte-Haddon Hall, Atlantic City, N. J. Week of June 23. C. L. Warwick, secretary-treasurer, 1315 Spruce St., Philadelphia, Pa.

Society of Automotive Engineers. Summer Meeting. June 24, 25, 26 and 27. Spring Lake, N. J. C. F. Clarkson, secretary, 29 W. 39th St., New York City.

American Society for Steel Treating. Sixth Convention, Boston, Mass., Sept. 22, 23, 24, 25 and 26. W. H. Eisenman, secretary, 4600 Prospect Ave., Cleveland, Ohio.

American Foundrymen's Association. Twenty-eighth annual convention. Milwaukee, Wis. Week of Oct. 13, 1924.

Management Week. Under the auspices of the American Society of Mechanical Engineers. Week of Oct. 20, 1924. New York City.

The Weekly Price Guide

Rise and Fall of the Market

Iron and Steel—Pig-iron demand still confined to small tonnage lots. No. 2 fdry. now $21, against $22 per ton a week ago. Slump in coke and pig-iron output. Steel mill operations down to 45 per cent of capactiy. June demand for steel products, however, appears better than that for the month preceding. There is continued improvement in demand for tank plates. Current steel quotations are: bars, $2.20@$2.25; shapes, $2.10@$2.25 and plates $2@$2.25 per 100 lb., f.o.b. mill. Little change has occurred in steel prices since June 6.

Non-Ferrous Metals—Demand for lead and tin is fairly good compared with that of other non-ferrous metals. Tin rose ¾c. and lead ¼c. per lb in New York warehouses since June 6. Foreign tin market advancing. Zinc dropped ¼c. and copper ¼c. per lb. during week ended June 13. Some improvement in foreign zinc market; antimony quiet.

(All prices as of June 13)

IRON AND STEEL

PIG IRON—Per gross ton—Quotations compiled by The Matthew Addy Co.:

CINCINNATI	
No. 2 Southern	$25.05
Northern Basic	24.00
Southern Ohio No. 2	24.00
NEW YORK—Tidewater Delivery	
Southern No. 2 (silicon 2.25@2.75)	28.00
BIRMINGHAM	
No. 2 Foundry	21.00
PHILADELPHIA	
Eastern Pa., No. 2x (silicon 2.25@2.75)	24.25
Virginia No. 2	28.17
Basic	24.00
Grey Forge	24.00
CHICAGO	
No. 2 Foundry local	24.50
No. 2 Foundry, Southern (silicon 2.25@2.75)	27.00
PITTSBURGH, including freight charge from Valley	
No. 2 Foundry	25.77
Basic	25.77
Bessemer	26.77

IRON MACHINERY CASTINGS—Cost in cents per lb. of 100 flywheels, 6-in. face x 24-in. dia., hub not cored, good quality gray iron, weight 275 lb.:

Detroit	4.75
Cleveland	4.75@5.00
Cincinnati	5.00@7.50
New York	5.00@5.50
Chicago	5.25@5.75

SHEETS—Quotations are in cents per pound in various cities from warehouse; also the mill base in large lots.

Blue Annealed	Pittsburgh	New York	Cleveland	Chicago
No. 10	$2.80@3.00	4.14	3.65	4.00
No. 12	2.90@3.10	4.19	3.70	4.05
No. 14	3.00@3.20	4.24	3.75	4.10
No. 16	3.20@3.40	4.34	3.85	4.20
Black				
Nos. 17 and 21	3.60@3.70	4.65	4.35	4.55
Nos. 22 and 24	3.65@3.75	4.70	4.40	4.55
Nos. 25 and 26	3.70@3.80	4.75	4.45	4.60
No. 28	3.75@3.85	4.85	4.55	4.70
Galvanized				
Nos 10 and 11	3.75@4.00	4.90	....	4.60
Nos 12 and 14	3.85@5.10	5.00	....	4.70
Nos. 17 and 21	4.15@4.40	5.30	....	5.00
Nos. 22 and 24	4.30@4.55	5.45	5.10	5.15
No. 26	4.45@4.70	5.55	5.35	5.30
No. 28	4.75@5.00	5.85	5.65	5.60

WROUGHT PIPE (Welded)—Warehouse discounts are as follows:

	New York		Cleveland		Chicago	
	Black	Galv.	Black	Galv.	Black	Galv.
1 to 3-in. steel butt welded	48%	34%	55½%	43½%	50%	37%
2½ to 6 in. steel lap welded	44%	30%	53½%	40½%	47%	34%

Malleable fittings: Classes B and C, banded, from New York stock sell at list plus 4%; class A, plus 23%. Cast iron, standard sizes, 34% off.

SEAMLESS STEEL TUBING—Following base discounts are on 20 gauge or .035-in., round, cold-drawn tubing, ¼-in. to 1-in., O.D., weighing 0,17 lb. to 0.36 lb. per ft. Cutting charge per 100 cuts, $1.50 to $1.58:

O.D. Inches	List Price per ft.	Differential Discount	O.D. Inches	List Price per ft.	Differential Discount
¼	$0.09	50%	⅞	$0.16	35%
⅜	.11	45%	1	.18	31%
½	.14	40%			

NOTE—The discounts are to be lowered by the following differentials in the case of regular .10-.20 carbon: 25,000 ft. or over, 83; 15,000 to 25,000 ft., 82; 5,000 to 15,000 ft., 81; 1,000 to 5,000 ft., 80; less than 1,000 ft., 79.

MISCELLANEOUS—Warehouse prices in cents per pound in 100-lb. lots:

	New York	Cleveland	Chicago
Open hearth spring steel (base)	4.50	6.00	4.20
Spring steel (light) (base)	7.00	6.00	6.00
Coppered Bessemer rods (base)	6.53	8.00	6.70
Hoop steel	4.59	4.66	4.55
Cold rolled strip steel	7.50	8.25	7.40
Floor plates	5.80	5.66	5.80
Cold drawn shafting or screw	4.40	4.10	4.00
Cold drawn flats, squares	4.90	4.60	4.50
Structural shapes (base)	3.59	3.46	3.30
Soft steel bars (base)	3.49	3.36	3.20
Soft steel bar shapes (base)	3.49	3.36	3.20
Soft steel bands (base)	4.09	3.61	3.95
Tank plates (base)	3.59	3.46	3.30
Bar iron (3.00 at mill)	3.49	3.36	3.20
Tool steel	11.00	....	....
Drill rod (from list)	60%	40@55%	50%

Electric welding wire, New York, 3/32, 8.35c.; ⅛, 7.85c.; 5/32 to ¼, 7.35c. per lb.

METALS

Current Prices in Cents Per Pound

Copper, electrolytic (up to carlots), New York			13.12½
Tin, 5-ton lots, New York			43.37½
Lead (up to carlots), St. Louis	6.95@7.00	New York	7.75
Zinc (up to carlots), St. Louis	5.80	New York	6.50

	New York	Cleveland	Chicago
Aluminum, 98 to 99% ingots, 1-15 ton lots	27.00	30.00	28.50
Antimony (Chinese), ton spot	9.00	10.50	10.00
Copper sheets, base	20.25	20.25@20.50	23.00
Copper wire, base	15.50	18.25	16.25
Copper bars, base	19.25	21.50	19.50
Copper tubing, base	22.25	26.50	23.00
Brass sheets, base	16.75	21.00	18.75
Brass tubing, base	21.00	26.00	20.50
Brass rods, base	14.50	17.00	15.75
Brass wire, base	17.25	21.00	....
Zinc sheets (casks)	10.50	10.75	....
Solder (½ and ½), (case lots)	33.50	30.00	30.00
Babbitt metal (83% tin)	60.00	53.00	48@52
Babbitt metal (35% tin)	28.00	17.50	23@26
Nickel (ingot and shot) f.o.b. refinery	27.00	....	....
Nickel (electrolytic) f.o.b. refinery	30.00	....	35.00
Nickel (F shot) f.o.b. refinery	30.00	....	....

SPECIAL NICKEL AND ALLOYS—Price in cents per lb., f.o.b Huntington, W. Va.:

Rolled nickel sheet (base)	52.00
Hot rolled rods, Grade "A" (base)	50.00
Cold drawn rods, Grade "A" (base)	58.00

Shop Materials and Supplies

METALS—Continued

Manganese nickel hot rolled rods "E"—low manganese (base) 54.00
Manganese nickel hot rolled rods "D"—high manganese (base) 57.00

Base price of monel metal in cents per lb., f.o.b. Huntington, W. Va.:

Shot	32.00	Hot rolled rods (base)	40.00
Blocks	32.00	Cold drawn rods (base)	48.00
Ingots	38.00	Hot rolled sheets (base)	42.00

OLD METALS—Dealers' purchasing prices in cents per pound:

	New York	Cleveland	Chicago
Copper, heavy, and crucible	10.00@10.75	10.00	10.75
Copper, heavy, and wire	9.62½@10.50	9.50	10.00
Copper, light, and bottoms	8.50@9.00	8.50	9.00
Lead, heavy	5.62½@6.00	5.00	6.50
Lead, tea	4.37½@5.00	3.00	5.50
Brass, heavy, yellow	6.50	.....	6.50
Brass, heavy, red	8.50@8.75	8.75	8.50
Brass, light	5.75	4.50	6.00
No. 1 yellow brass turnings	6.50@6.75	5.50	6.50
Zinc	3.50@3.75	3.50	3.50

TIN PLATES—American Charcoal—Bright—Per box.

		New York	Cleveland	Chicago
"AAA" Grade:				
IC,	20x28, 112 sheets	$24.30	$22.85	$18.50
"A" Grade:				
IC,	20x28, 112 sheets	20.20	18.00	17.00
	Coke Plates—Primes, 20x28 in.			
100-lb.,	112 sheets	14.00	13.00	14.50
	Terne Plates—Small lots, 8-lb. Coating			
IC,	14x20	8.25	6.55	7.40

MISCELLANEOUS

	New York	Cleveland	Chicago
Cotton waste, white, per lb.	$0.14@0.21	$0.20	$0.14
Cotton waste, colored, per lb.	.09@.12½	.17	.10½
Wiping cloths, 13¼x13¾, per lb	10.75†	36.00 per M	.16
Wiping cloths, 13¼x20½, per lb.	....	52.00 per M	.16
Sal soda, per 100 lb.	2.40	2.25	2.65
Roll sulphur, per 100 lb.	3.60	3.25	3.50
Linseed oil, per gal., 5 bbl. lots	.98	1.09	.94
Lard cutting oil, 25% lard, per gal.	.55	.50	.79*
Machine lubricant, medium-bodied (50 gal. wooden bbl.), per gal.	.29	.35	.40
Belting—Present discounts from list in fair quantities (½ doz. rolls).			
Leather—List price, 24c. per lin. ft. per inch of width for single ply.			
Medium grade	40–2½%	30–10%	30–10%
Heavy grade	30–5%	30%	20–5–2½%
Rubber transmission:			
First grade	50%	50–10%	40–10%
Second grade	50–10%	60–5%	60–5%
Abrasive materials—In sheets 9x11 in., No. 1 grade, per ream of 480 sheets:			
Flint paper	$5.40	$5.84	$6.48
Emery paper	9.90	11.00	8.80
Emery cloth	31.12	31.12	29.48
Emery disks, 6 in. dia., No. 1 grade, per 100:			
Paper	1.49	1.24	1.40
Cloth	3.38	2.67	3.20
Fire clay, per 100 lb. bag	.....	.65	.60
Coke, prompt furnace, Connellsville	per net ton		3.25@3.50
Coke, prompt foundry, Connellsville	per net ton		4.50@5.00
White lead, dry or in oil	100 lb. kegs		New York, 15.00
Red lead, dry	100 lb. kegs		New York, 15.00
Red lead, in oil	100 lb. kegs		New York, 16.50

*Chicago quotes on pure lard oil, No. 1 grade.
†White, at washery.

Comparative Warehouse Prices

New York	Unit	Current Price	Four Weeks Ago	One Year Ago
Soft steel bars	per lb.	$0.0349	$0.0349	$0.0354
Cold finished shafting	per lb.	0.044	0.044	0.044
Brass rods	per lb	0.145	0.15	0.1875
Solder (½ and ½)	per lb.	0.335	0.37	0.315
Cotton waste	per lb.	.14@.21	.14@.21	.10@.13
Washers, cast iron (½ in.)	per 100 lb.	6.50	6.50	6.50
Emery, disks, cloth, No. 1, 6 in. dia.	per 100	3.38	3.38	3.38
Lard cutting oil	per gal.	0.55	0.55	0.65
Machine oil	per gal.	0.29	0.29	0.297
Belting, leather, medium	off list	40–2½%	40–2½%	30–10%
Machine bolts up to 1x30 in.	off list	50%	45%	30%

SHOP SUPPLIES

Current Discounts from Standard Lists

	New York	Cleveland	Chicago
Machine Bolts:			
All sizes up to 1x30 in.	50%	60–10–5%	55–5%
1⅛ and 1¼x3 in. up to 12 in.	15%	60%	50%
With cold punched hex. nuts up to 1 in. diam. (plus std. extra of 10%)	40%	$3.50 net	.....
With hot pressed hex. nuts up to 1x30 in. (plus std. extra of 10%)	45%	3.50 net	$4.00 off
Button head bolts, with hex. nuts	10%	List net	3.50
Hex. head and hex. nut bolts	10%	.....List plus 10%	
Lag screws, coach screws	50%	.....	50-5%
Square and hex. head cap screws	75%	75%	75–5%
Carriage bolts, up to 1 in.x30 in.	40%	60%	50–5%
Bolt ends, with hot pressed nuts	50%	.....	55-5%
Tap bolts, hex. head, list plus	35%	.....	.....
Semi-finished nuts, $\frac{5}{16}$ and smaller	70%	.....	.....
Semi-finished nuts, ⅝ and larger	65%	70%	80%
Case-hardened nuts	50%	.....	.....
Washers, cast iron, ½ in., per 100 lb. (net)	$6.50	$4.00	$4.00
Washers, cast iron, ⅝ in., per 100 lb. (net)	5.50	4.00	4.00
Washers, round plate, per 100 lb. Off list	1.50	4.50	4.00
Nuts, hot pressed, sq., per 100 lb. Off list	1.50	4.00	3.50
Nuts, hot pressed, hex., per 100 lb. Off list	1.50	4.00	3.50
Nuts, cold punched, sq., per 100 lb. Off list	1.50	4.00	3.50
Nuts, cold punched, hex., per 100 lb. Off list	1.50	4.00	3.50
Rivets:			
Rivets, $\frac{7}{16}$ in. dia. and smaller	50%	60–10%	60%
Rivets, tinned	50%	60–10%	4½c. net
Button heads ¾-in., ⅞-in., 1x2 in. to 5 in., per 100 lb. (net)	$5.00	$3.50	$3.75
Cone heads, ditto (net)	5.20	3.60	3.95
1¼ to 2-in. long, all diameters, *EXTRA* per 100 lb.	0.25	.....	0.15
⅝ in. diameter *EXTRA*	0.35	.....	0.15
½ in. diameter *EXTRA*	0.75	.....	0.50
1 in. long, and shorter *EXTRA*	0.75	.....	0.50
Longer than 5 in. *EXTRA*	0.50	.....	0.25
Less than 200 lb. *EXTRA*	0.50	.....	0.50
Countersunk heads *EXTRA*	0.45	.....	$4.20 base

Machine Requirements and Industrial Construction

Machine Tools and Equipment Wanted

Conn., Bridgeport — Bridgeport Safety Emery Wheel Co., Knowlton St.—traveling crane to lift machinery weighing at least 20,000 lbs.

Conn., Hartford—City, School Com.—about $50,000 worth of manual training equipment.

D. C., Wash.—Chief of Engineers, United States Army—receiving bids until June 20 for engine lathe, bench grinder and shaper.

Ill., Rockford—Old Colony Chair Co., 1109 Seminary St.—woodworking machinery, including sticker and sander.

Mass., Boston — School — House Dept., City Hall, T. P. Glynn, Chn.—receiving bids until June 20 for metal working machinery for Grant School, Phillips St., West End Dist.; woodworking machinery for Henry L. Pierce School, Washington St. and Wells Ave., Dorchester Dist.

Mass., Boston—S. M. Spencer Mfg. Co., 9 Cornhill St. (stencils and stamps)—bending machine, rolls, 24 to 30 in. long, to bend ⅛ in. brass.

Mich., Baraga—H. Clausen—large planing mill and bandsaw.

Mich., Detroit—Detroit Gray Iron Fdrys. Co., 6403 Wight St.—foundry equipment.

Minn., Minneapolis—Electric Mchy. Mfg. Co., 1331 North East Tyler St., S. W. Palmer, Mgr.—one 4 ton electric crane and one key feeding machine, later.

N. Y., Buffalo—Mosier & Summers, 1266 Seneca St.—planing mill machinery.

N. Y., Central Square—T. Matthys (machine shop)—12 to 18 in. back geared engine lathe.

N. Y., Grieg—Laszle-Tock Co., J. Laszle, Purch. Agt.—sheet metal working machinery and equipment for the manufacture of brass fire extinguishers; also tool makers lathe (used).

N. Y., Pulaski—H. F. Billhardt, 23 North St. (machine shop)—machine tools for motor repair.

N. Y., Sacket Harbor—F. S. Ramsey (lumber)—sawmill machinery and equipment.

N. Y., Watertown—Parkside Motor Co., State St., F. Krakowka, Purch. Agt.—tool room lathe and post driller.

N. Y., Wellsburg—G. F. Hanlon (lumber)—sawmill equipment, including portable saw rig, gas motor drive.

O., Columbus — Artcraft Metal Products Co., 269 West Spring St. (gas ranges, etc.), A. W. Zuhars, Pres.—two metal presses, 60 ton capacity each.

O., Hamilton—Doron Bros. Electrical Co.—machine for bending cold rolled steel ⅞ in. in diameter.

Vt., Barre—Boutwell, Milne & Varnum Co.—machine tools and equipment for proposed machine shop at Graniteville, later.

Vt., Burlington—City, J. Jackson, Mayor—machine and woodworking tools for manual training department of proposed school.

Wis., Green Bay—F. H. Malzahn, 711 Howard St. (sheet metal work)—8 ft. cornice brake.

Wis., Milwaukee—Oilgear Co., 398 38th St.—machine tools, including lathes and drill presses.

Wis., Milwaukee—R. E. Schlei Co., 764 32d St.—tool room lathe, drill press, emery grinder, etc., for garage.

Wis., Shorewood (Milwaukee P. O.)—School Dist. 4, H. Kuechenmeister, Clk.—manual training machinery and equipment for proposed shop.

Ont., Bridgeburg — Horton Steel Wks., Ltd., W. R. Manock, Mgr.—one rotary planer, 48 or 50 in. head preferred.

Que., Montreal—Beaudry & Paquin, Blvd. Gouin—drilling machine.

Que., Montreal—L. Demers, 646 De Fleurimont St.—complete equipment for new garage.

Que., Montreal—L. Gau, 256 St. Antoine St.—general equipment for machine shop.

Que., Montreal—Girouard Taxi Service, St. Dominique St., J. E. Girouard, Purch. Agt.—bench lathe and drill press for motor repairs.

Que., Westmount—Warren Radio Phone Mfg. Co., Ltd., c/o H. E. Walker, 3 Belevedere Rd.—special machinery and tools for the manufacture of radio apparatus.

Opportunities for Future Business

Ala., Birmingham—The Continental Gin Co., Guarantee Bldg., awarded the contract for the construction of a 1 story, 135 x 400 ft. foundry and 150 x 300 ft. machine shop. Estimated cost $750,000.

Calif., Eureka—The Humboldt Lumber & Bldg. Co., 233 G St., is having plans prepared for the construction of a saw and planing mill, dry kilns, etc., capacity 50,000 ft. per day. D. H. McFarlan, Mgr. Private plans.

Calif., Huntington Park (Branch of Los Angeles)—The United States Steel Products Co., 156 North Central Ave., Los Angeles, plans to build a factory and warehouse on a 7 acre site, here. Cost will exceed $40,000.

Calif., Los Angeles — R. R. Meads, 418 East 8th St., representing owners, is having plans prepared for the construction of an 8 story, 80 x 175 ft. garage on Hope St. Noerenberg & Johnson, Railway Bldg., Archts.

Calif., San Bernardino—The Atchison, Topeka and Santa Fe Ry. Co., Kerchkoff Bldg., Los Angeles, awarded the contract for the construction of a 100 x 193 ft. sheet metal plant and a 45 x 180 ft. flue shop, here. Estimated cost $60,000.

Conn., Bridgeport—D. W. Flint, Inc., Allens Ave., Providence, R. I., is having plans prepared for the construction of a 2 story, 130 x 160 ft. garage and showroom on West and State Sts., here. Estimated cost $150,000. Fletcher-Thompson Co., 542 Fairfield Ave., Engrs. and Archts.

Conn., Stratford (Branch of Bridgeport)—The Bridgeport Safety Emery Wheel Co., Knowlton St., Bridgeport, awarded the contract for the construction of a 1 story, 90 x 240 ft. factory on Stratford Ave., here. Noted Apr. 17.

Ind., Batesville—The Union Furniture Co. is receiving bids for the construction of a 4 story, 18 x 72 ft. factory. Estimated cost $50,000. M. Fisher, Brighton Bank Bldg., Cincinnati, O., Engr. Noted June 12.

Ind., Richmond—The F. and N. Lawn Mower Co. is having plans prepared for the construction of a 4 story, 75 x 100 ft. factory. Estimated cost $100,000. J. Mueller & Co., Palladium Bldg., Archt.

Ia., Marshalltown — The Fisher Supply Co., manufacturer of steam specialties and milling machines, awarded the contract for the construction of a 2 story, 60 x 125 ft. factory. Estimated cost $40,352.

Mass., Boston — The city, Pub. Bldg. Dept., City Hall, is having plans prepared for the construction of a shop addition to Charlestown High School. Estimated cost $40,000. G. S. McLaughlin, 80 Boylston St., Engr.

Mass., Boston—The Union Realty Co., c/o H. F. Livermore, 100 Cummington St., awarded the contract for the construction of a 2 story, 75 x 240 ft. machine shop on Linden St. Estimated cost $100,000. Noted May 22.

Mass., Brockton — Goodman Bros., 25 Pleasant St., will build a 1 story, 100 x 400 ft. garage on North Main St. Estimated cost $150,000.

Mass., Charlestown (Boston P. O.)—The City, School House Dept., T. P. Glynn, Chn., City Hall, Boston, plans to build a wood and metal working shop addition to Warren-Bunker Hill Elementary School, here. Estimated cost $40,000.

Mass., West Lynn (Lynn P. O.)—The Genl. Electric Co. awarded the contract for the construction of a 1 story, 80 x 120 ft. maintenance plant. Cost will exceed $50,000.

Mich., Detroit — The Detroit Gray Iron Fdrys. Co., 6403 Wight St., is having plans prepared for the construction of a 2 story, 50 x 80 ft. addition to its foundry on Iron St. Estimated cost $40,000. Mildner & Eisen, 924 Hammond Bldg., Archts.

Minn., Minneapolis—The Electric Mchy. Mfg. Co., 1331 Tyler St., North, will build a 2 story, 134 x 182 ft. addition to its factory. Estimated cost $72,000.

Miss., Jackson—The Amer. Box & Lumber Co. will build a 100 x 140 ft. mill with 30 x 85 ft. extension, 60 x 450 ft. assorting building, 14 x 200 ft. unloading shed, etc., capacity of plant 100,000 ft. per day. Estimated cost $150,000. Noted May 29.

Miss., Lyman — The Batson & Hatten Lumber Co. awarded the contract for the construction of a 72 x 258 ft. plant. N. P. Hatten, Treas.

Mo., Poplar Bluff—The Bimel Ashcroft Mfg. Co. will rebuild its sawmill and turning plant, recently destroyed by fire. Estimated cost $65,000.

N. Y., Buffalo—Mosier & Summers, 1266 Seneca St., plans to rebuild planing mill which was destroyed by fire. Estimated cost $40,000.

N. Y., Green Island (Troy P. O.)—The Ford Motor Co., Highland Park (Detroit P. O.), Mich., plans to build a 1 or 2 story, 200 x 1,300 ft. addition to its factory, here. Estimated cost $1,800,000.

O., Cleveland—The Abrams Realty Co., c/o L. Abrams, Engineers Bldg., awarded the contract for the construction of a 1 and 2 story, 116 x 240 ft. garage on East 79th St. and Lexington Ave. Estimated cost $175,000.

O., Cleveland—The W. S. Tyler Co., 3613 Superior Ave., manufacturer of ornamental iron work, had plans prepared for the construction of a 2 story factory on East 36th St. and Superior Ave. Estimated cost $150,000. G. S. Rider & Co., Century Bldg., Archt.

O., Hamilton—The Ford Motor Co., Highland Park (Detroit P. O.), Mich., awarded the contract for the construction of a 1 story, 102 x 201 ft. addition to forge shop on 4th St., here. Estimated cost $90,000. Noted May 15.

Pa., Berwick—The Berwick Lumber & Supply Co. plans to rebuild its planing mill which was destroyed by fire. Cost from $160,000 to $175,000.

Pa., Phila.—The Moore Push Pin Co., Berkley St. between Wayne Ave. and Greene St., awarded the contract for the construction of a 1 story, 60 x 125 ft. factory. Estimated cost $35,000. Noted May 29.

Pa., Phila. — S. Stern, 1006 Vine St., awarded the contract for the construction of a 2 story, 32 x 80 ft. sheet metal shop at 1015-17 Winter St. Estimated cost $11,000.

Pa., St. Davids—The Wayne Iron Wks., Commercial Trust Bldg., Phila., will soon award the contract for the construction of a 1 story, 49 x 74 ft. shop, here. P. M. Sax, Penfield Bldg., Phila., Engr.

Pa., Upper Darby (Phila. P. O.)—G. Wilcox, Land Title Bldg., Phila., awarded the contract for the construction of a 2 story, 100 x 196 ft. motor building on Brief Ave. and 69th St., here. Estimated cost $175,000.

Vt., Graniteville — Boutwell, Milne & Varnum Co., Barre, awarded the contract for the construction of a 2 story, 50 x 160 ft. machine shop, here. Estimated cost $70,000.

Ont., North Bay—The Temiskaming & Northern Ontario Ry. awarded the contract for the construction of shops. Estimated cost $75,000.